Parallels

Parallels Virtuozzo Containers for Linux

User's Guide

Version 4.0

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Parallels Holdings Ltd.
13755 Sunrise Valley Drive
Suite 600
Herndon, VA 20171
USA
Tel: +1 (703) 815 5670
Fax: +1 (703) 815 5675

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CHAPTER 1

Preface

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About This Guide

This guide is meant to provide comprehensive information on Parallels Virtuozzo Containers 4.0 – high-end server virtualization software for Linux-based servers. The issues discussed in this guide cover the necessary theoretical conceptions as well as practical aspects of working with Virtuozzo Containers. The guide will familiarize you with the way to create and administer Containers (sometimes also called *Virtual Environments*, or *VEs*) on Virtuozzo-based Hardware Nodes and to employ both graphical and command line interfaces for performing various tasks.

Note: The guide does not familiarize you with the process of installing, configuring, and deploying your Virtuozzo system. Detailed information on all these operations is provided in the Parallels Virtuozzo Containers Installation Guide shipped with Virtuozzo Containers 4.0.

According to the task-oriented approach, most topics of this guide are devoted to a particular task and the ways to perform it. However, Virtuozzo Containers 4.0 is equipped with as many as three different tools to perform many administrative tasks:

- the command line interface
- Parallels Management Console with the graphical user interface
- Parallels Infrastructure Manager with web interface.

Besides, there is another tool for managing Containers - Parallels Power Panel. However, this tool is mainly regarded as a means for individual Container customers to manage their personal Containers and is therefore not described in this guide.

Parallels Management Console and the command line interface are considered the primary tools for administering Virtuozzo Containers 4.0 and performing main administrative tasks on Hardware Nodes and in the Container context. Therefore, when describing the ways to perform this or that task, we have provided the corresponding algorithms only for Parallels Management Console and the command line interface. As to Parallels Power Panel and Parallels Infrastructure Manager, a web counterpart of Management Console, they are provided with a comprehensive online help system.

Certain Linux administrator's skills are desirable for a person reading the guide. If you foresee any problems with setting up Linux on your server (for example, related to disk partitioning), you may consult Parallels Support Team (see Getting Technical Support (p. 388) for contacts). In addition, you can obtain some useful information regarding Red Hat OS installation issues from http://www.redhat.com/docs/manuals/linux/.

Organization of This Guide

Chapter 2, Virtuozzo Philosophy, is a must-read chapter that helps you grasp the general principles of Virtuozzo operation. It provides an outline of Virtuozzo architecture, of the way Virtuozzo Containers 4.0 stores and uses configuration information, of the things you as administrator are supposed to perform, and the common way to perform them. It also lets you understand Virtuozzo licensing policy.

Chapter 3, Operations on Containers, covers those operations that you may perform on a Container as on a single entity: creating and deleting Containers, starting and stopping them, backing up and restoring, etc. You will also learn from this chapter how to migrate Containers from one Hardware Node to another.

Chapter 4, Managing Resources, zeroes in on configuring and monitoring the resource control parameters for different Containers. These parameters comprise disk quotas, network accounting and shaping, CPU and system resources. Common ways of optimizing your Containers configurations are suggested at the end of the chapter.

Chapter 5, Real-Time Monitoring in Parallels Virtuozzo Containers, explains the way to keep track of the consumption of all kind of resources by running Containers and the Hardware Node itself in real time. Configuring Parallels Management Console and the Monitor Node for sending alerts is part and parcel of the monitoring process.

Chapter 6, Managing Services and Processes, familiarizes you with the operations you can perform on processes and services in Parallels Virtuozzo Containers by using both the command-line utilities and Parallels Management Console graphical interface.

Chapter 7, Managing Virtuozzo Network, familiarizes you with the Virtuozzo network structure, enumerates Virtuozzo networking components, and explains how to manage these components in Virtuozzo-based systems.

Chapter 8, Managing Hardware Nodes, centers on all those operations you as Hardware Nodes administrator can perform on your Nodes.

Chapter 9, Keeping Your Virtuozzo System Up-to-Date, serves as a reference on the ways to keep all the software components of a Hardware Node up-to-date.

Chapter 10, Compatibility With Previous Versions of Virtuozzo Containers, provides information on compatibility issues between Parallels Virtuozzo Containers 4.0 and previous versions of Virtuozzo Containers and the ways to solve them.

Chapter 11, Advanced Tasks, enumerates those tasks that are intended for advanced system administrators who would like to obtain deeper knowledge about Virtuozzo capabilities.

Chapter 12, Mastering Parallels Management Console, focuses on those tasks that are most comfortably accomplished using not the command-line utilities, but Parallels Management Console graphical interface.

Chapter 13, Troubleshooting, suggests ways to resolve common inconveniences should they occur during your work with the Parallels Virtuozzo Containers software.

Documentation Conventions

Before you start using this guide, it is important to understand the documentation conventions used in it. For information on specialized terms used in the documentation, see the Glossary at the end of this document.

The table below presents the existing formatting conventions.

Formatting convention	Type of Information	Example
Triangular Bullet(➢)	Step-by-step procedures. You can follow the instructions below to complete a specific task.	***To create a Container:***
Special Bold	Items you must select, such as menu options, command buttons, or items in a list.	Go to the **Resources** tab.
	Titles of chapters, sections, and subsections.	Read the **Basic Administration** chapter.
Italics	Used to emphasize the importance of a point, to introduce a term or to designate a command line placeholder, which is to be replaced with a real name or value.	These are the so-called *EZ templates*. To destroy a Container, type `vzctl destroy` *`ctid`*.
`Monospace`	The names of commands, files, and directories.	Use `vzctl start` to start a Container.
`Preformatted`	On-screen computer output in your command-line sessions; source code in XML, C++, or other programming languages.	`Saved parameters for Container 101`
`Monospace Bold`	What you type, as contrasted with on-screen computer output.	**`# rpm –V virtuozzo-release`**
CAPITALS	Names of keys on the keyboard.	SHIFT, CTRL, ALT
KEY+KEY	Key combinations for which the user must press and hold down one key and then press another.	CTRL+P, ALT+F4

Besides the formatting conventions, you should also know about the document organization convention applied to Parallels documents: chapters in all guides are divided into sections, which, in turn, are subdivided into subsections. For example, **About This Guide** is a section, and **Documentation Conventions** is a subsection.

Getting Help

In addition to this guide, there are a number of other resources shipped with Virtuozzo Containers 4.0 which can help you use the product more effectively. These resources include:

- Manuals:
  - Parallels Virtuozzo Containers Evaluation Guide. This guide is destined to introduce you to the main features of Virtuozzo Containers 4.0 and to its underlying technology, to help you set up an environment for evaluating the Virtuozzo major features, and to suggest the relevant procedures for this evaluation.
  - Getting Started With Parallels Virtuozzo Containers for Linux. This guide provides basic information on how to install Parallels Virtuozzo Containers 4.0 on your server, create new Containers, and perform main operations on them. As distinct from the given guide, it does not contain detailed description of all the operations needed to install and set Parallels Virtuozzo to work (e.g. planning the structure of your Virtuozzo network or performing the Virtuozzo Containers unattended installation).
  - Parallels Virtuozzo Containers for Linux Installation Guide. This guide provides exhaustive information on the process of installing, configuring, and deploying your Virtuozzo system. As distinct from the Getting Started With Parallels Virtuozzo Containers for Linux guide, it contains a more detailed description of all the operations needed to install and set Virtuozzo Containers 4.0 to work including planning the structure of your Virtuozzo network, performing the Virtuozzo Containers unattended installation, etc. Besides, it does not include the description of any Container-related operations.
  - Parallels Virtuozzo Containers for Linux Templates Management Guide. This guide is meant to provide complete information on Virtuozzo templates - an exclusive Parallels technology allowing you to efficiently deploy standard Linux applications inside your Containers and to greatly save the Hardware Node resources (physical memory, disk space, etc.).
  - Parallels Virtuozzo Containers for Linux Reference Guide. This guide is a complete reference on all Parallels Virtuozzo configuration files and Hardware Node command-line utilities.
- Help systems:
  - Parallels Management Console Help. This help system provides detailed information on Parallels Management Console - a graphical user interface tool for managing Virtuozzo Hardware Nodes and their Containers.
  - Parallels Infrastructure Manager Online Help. This help system shows you how to work with Parallels Infrastructure Manager - a tool providing you with the ability to manage Virtuozzo Hardware Nodes and their Containers with the help of a standard Web browser on any platform.
  - Parallels Power Panel Online Help. This help system deals with Parallels Power Panel - a means for administering individual Containers through a common Web browser on any platform.

Feedback

If you spot a typo in this guide, or if you have thought of a way to make this guide better, we would love to hear from you!

The ideal place for your comments and suggestions is the Parallels documentation feedback page (http://www.parallels.com/en/support/usersdoc/).

CHAPTER 2

Virtuozzo Containers Philosophy

In This Chapter

About Virtuozzo Containers Software 19
Distinctive Features of Parallels Virtuozzo Containers 4.0 21
Main Principles of Virtuozzo Operation 24
Hardware Node Availability Considerations 33

About Virtuozzo Containers Software

What is Parallels Virtuozzo

Parallels Virtuozzo Containers is a patented OS virtualization solution. Virtuozzo Containers 4.0 creates isolated partitions or Containers on a single physical server and OS instance to utilize hardware, software, data center and management effort with maximum efficiency. The basic Virtuozzo capabilities are:

- **Intelligent Partitioning** - Division of a server into as many as hundreds of Containers with full server functionality.
- **Complete Isolation** - Containers are secure and have full functional, fault and performance isolation.
- **Dynamic Resource Allocation** - CPU, memory, network, disk and I/O can be changed without rebooting.
- **Mass Management** - Suite of tools and templates for automated, multi-Container and multi-server administration.

The diagram below represents a typical model of the Virtuozzo-based system structure:

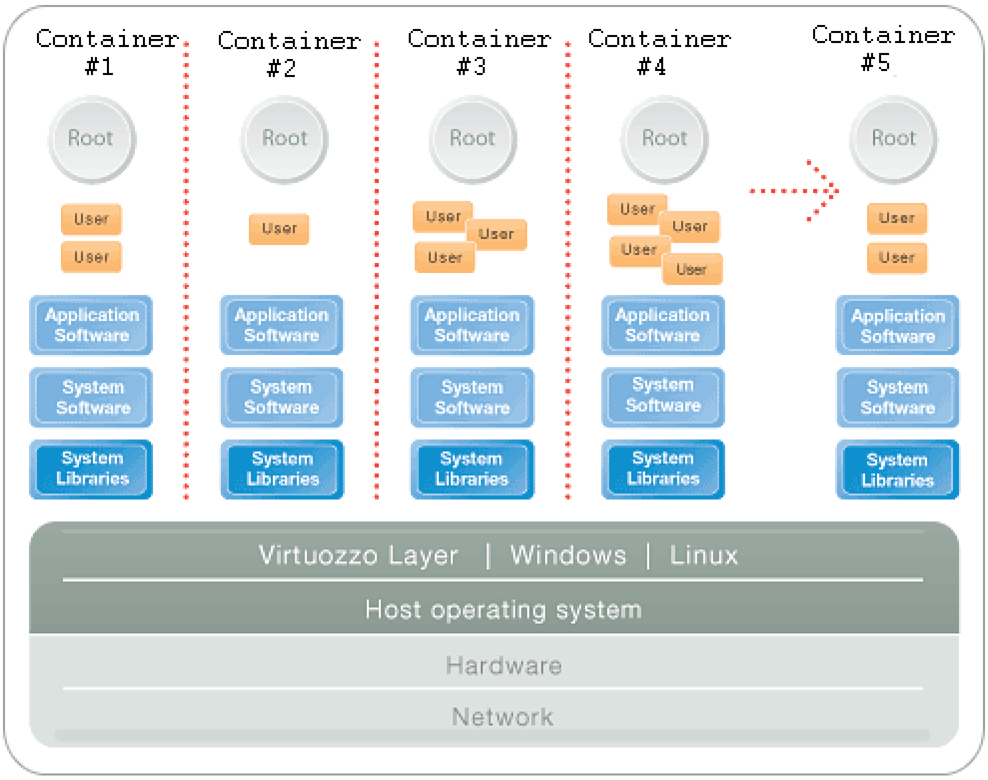

Figure 1: Virtuozzo Containers OS Virtualization

The Parallels Virtuozzo OS virtualization model is streamlined for the best performance, management, and efficiency. At the base resides a standard Host operating system which can be either Windows or Linux. Next is the virtualization layer with a proprietary file system and a kernel service abstraction layer that ensure the isolation and security of resources between different Containers. The virtualization layer makes each Container appear as a standalone server. Finally, the Container itself houses the application or workload.

The Parallels Virtuozzo OS virtualization solution has the highest efficiency and manageability making it the best solution for organizations concerned with containing the IT infrastructure and maximizing the resource utilization. The Parallels Virtuozzo complete set of management tools and unique architecture makes it the perfect solution for easily maintaining, monitoring, and managing virtualized server resources for consolidation and business continuity configurations.

Virtuozzo Applications

Parallels Virtuozzo Containers is often bundled with HSPComplete, a comprehensive solution for Hosting Service Providers, based on the Virtuozzo technology. Virtuozzo Containers 4.0 allows Hosting Service Providers to:

- Have hundreds of customers with their individual full-featured virtual private servers (Containers) sharing a single physical server;
- Provide each customer with a guaranteed Quality of Service;
- Transparently move customers and their environments between servers, without any manual reconfiguration.

While Virtuozzo Containers 4.0 is effectively coupled with HSPComplete as well as with other hosting automation solutions, the scope of its application is not limited to them.

If you administer a number of Linux dedicated servers within an enterprise, each of which runs a specific service, you can use Virtuozzo Containers 4.0 to consolidate all these servers onto a single sever without losing a bit of valuable information and without compromising performance. Containers behave just like an isolated stand-alone server:

- Each Container has its own processes, users, files and provides full root shell access;
- Each Container has its own IP addresses, port numbers, filtering and routing rules;
- Each Container can have its own configuration for the system and application software, as well as its own versions of system libraries. It is possible to install or customize software packages inside a Container independently from other Containers or the host system. Multiple distributions of a package can be run on one and the same Linux box.

In fact, hundreds of servers may be grouped together in this way. Besides the evident advantages of such consolidation (increased facility of administration and the like), there are some you might not even have thought of, say, cutting down electricity bills by times!

Virtuozzo Containers 4.0 proves invaluable for IT educational institutions that can now provide every student with a personal Linux server, which can be monitored and managed remotely. Software development companies may use Containers for testing purposes and the like.

Thus, The Virtuozzo Containers software can be efficiently applied in a wide range of areas: web hosting, enterprise server consolidation, software development and testing, user training, and so on.

Virtuozzo Containers 64-bit vs. Virtuozzo Containers 32-bit

The Virtuozzo Containers 32-bit version has been ported to support the x86-64 and IA-64 processors, which allows you to use virtually any Virtuozzo Tool and utility under the Virtuozzo Containers 64-bit versions in exactly the same way as you would use it on the servers with standard 32-bit processors. However, while working with the 64-bit versions of Parallels Virtuozzo Containers, you should keep in mind a number of peculiarities specific for the corresponding Virtuozzo Containers 64-bit version and described in the table below:

Functionality	32-bit	64-bit for x86-64	64-bit for IA-64
Creating Containers on the basis of 32-bit OS templates.	yes	yes	no
Adding 32-bit application templates to your Containers.	yes	no*	no
***Note:** You can add 32-bit application templates to Containers created under the Virtuozzo Containers 64-bit version for the x86-64 processors and based on 32-bit OS templates.*			
Migrating Containers based on 32-bit OS templates.	yes	yes	no
Migrating Containers based on 64-bit OS templates.	no	yes	yes
Note: You can move Containers created under the corresponding Virtuozzo Containers 64-bit version only to Hardware Nodes running the same Virtuozzo Containers 64-bit version. So, a Container created under the Virtuozzo Containers version for the IA-64 processors can be migrated only to a Hardware Node with the same Virtuozzo Containers version installed.			

Except for these points, using Virtuozzo Containers 4.0 for 64-bit processors does not differ from working with its 32-bit counterpart. For example, you can use any Hardware Node as a Backup Node irrespective of a Virtuozzo Containers version installed on this Node. So, you can back up a Container from the Node running the Virtuozzo Containers 32-bit version and store it on the Node running any Virtuozzo Containers 64-bit version and vice versa. More information on Container backups is provided in the Backing Up and Restoring Containers section (p. 68).

Distinctive Features of Parallels Virtuozzo Containers 4.0

The concept of Virtuozzo Containers is distinct from the concept of traditional virtual machines in the respect that Containers always run the same OS kernel as the host system (Linux on Linux, Windows on Windows, etc.). This single-kernel implementation technology allows to run Containers with a near-zero overhead. Thus, Virtuozzo Containers offer an order of magnitude higher efficiency and manageability than traditional virtualization technologies.

OS Virtualization

From the point of view of applications and Container users, each Container is an independent system. This independency is provided by a virtualization layer in the kernel of the host OS. Note that only a negligible part of the CPU resources is spent on virtualization (around 1-2%). The main features of the virtualization layer implemented in Parallels Virtuozzo Containers are the following:

- Container looks like a normal Linux system. It has standard startup scripts, software from vendors can run inside Container without Virtuozzo-specific modifications or adjustment;
- A user can change any configuration file and install additional software;
- Containers are fully isolated from each other (file system, processes, Inter Process Communication (IPC), `sysctl` variables);
- Containers share dynamic libraries, which greatly saves memory;
- Processes belonging to a Container are scheduled for execution on all available CPUs. Consequently, Containers are not bound to only one CPU and can use all available CPU power.

Virtuozzo File System (VZFS)

VZFS is a file system that allows to share common files among multiple Containers without sacrificing flexibility. It is possible for Container users to modify, update, replace, and delete shared files. When a user modifies a shared file, VZFS creates a private copy of the file transparently for the user. Thus, the modifications do not affect the other users of the file. Main benefits of VZFS are the following:

- It saves memory required for executables and libraries. A typical Container running a simple web site might consume around 20–30 MBytes of RAM just for executable images. Sharing this memory improves scalability and total system performance;
- It saves disk space. A typical Linux server installation occupies several hundred MBytes of disk space. Sharing the files allows you to save up to 90% of disk space;
- VZFS does not require having different physical partitions for different Containers or creating a special “file system in a file” setup for a Container. This significantly simplifies disk administration;
- Disk quota enables the administrator to limit disk resources available to a Container on-the-fly, in the same manner as the standard disk quota system works on a per-user basis. Disk quota for users and groups inside Containers is also supported.

Templates

A template (or a package set) in Parallels Virtuozzo Containers is a set of original application files repackaged for mounting over Virtuozzo File System. Usually it is just a set of RPM packages for Red Hat like systems. Virtuozzo Containers 4.0 provides tools for creating templates, installing, upgrading, adding them to and removing them from a Container. Using templates lets you:

- Share the RAM among similar applications running in different Containers to save hundreds of megabytes of memory;
- Share the files comprising a template among different Containers to save gigabytes of disk space;
- Deploy applications simultaneously in many Containers;
- Use different versions of an application on different Containers (for example, perform an upgrade only in certain Containers).

There are two types of templates in Virtuozzo Containers 4.0. These are OS templates and application templates. An OS template is an operating system and the standard set of applications to be found right after the installation. Parallels Virtuozzo Containers uses OS templates to create new Container with a preinstalled operating system. An application template is a set of repackaged software packages optionally accompanied with configuration scripts. The Virtuozzo Containers software uses application templates to add extra software to the existing Container. For example, you can create a Container on the basis of the `redhat` OS template and add the MySQL application to it with the help of the `mysql` template.

For detailed information on Parallels Virtuozzo templates, please see the Parallels Virtuozzo Containers Templates Management Guide.

Resource Management

Virtuozzo Resource Management controls the amount of resources available to Containers. The controlled resources include such parameters as CPU power, disk space, a set of memory-related parameters. Resource management allows Virtuozzo Containers 4.0 to:

- Effectively share available Hardware Node resources among Containers;
- Guarantee Quality-of-Service in accordance with a service level agreement (SLA);
- Provide performance and resource isolation and protect from denial-of-service attacks;
- Simultaneously assign and control resources for a number of Containers;
- Manage a multitude of Hardware Nodes in a unified way by means of Parallels Management Console and Parallels Infrastructure Manager;
- Collect usage information for system health monitoring, etc.

Resource Management is much more important for Virtuozzo Containers 4.0 than for a standalone server since server resource utilization in a Virtuozzo-based system is considerably higher than that in a typical system.

Main Principles of Virtuozzo Operation

Basics of Virtuozzo Technology

In this section we will try to let you form a more or less precise idea of the way the Virtuozzo Containers software operates on your computer. Please see the figure below:

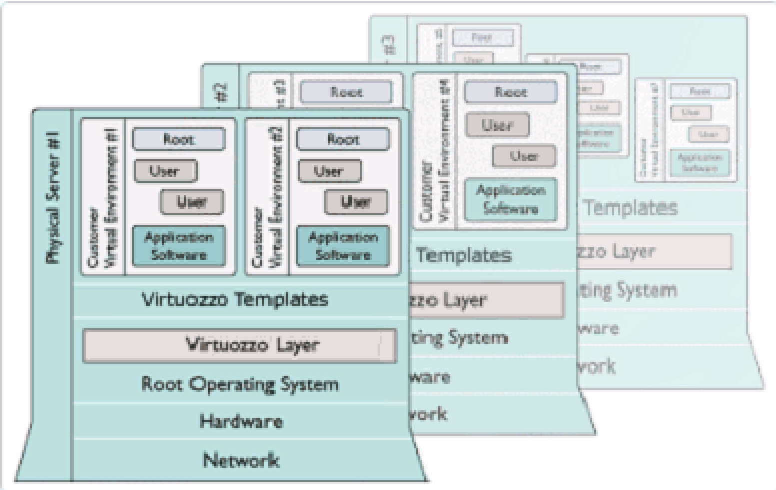

Figure 2: Virtuozzo Technology

This figure presumes that you have a number of physical servers united into a network. In fact, you may have only one dedicated server to effectively use the Virtuozzo Containers software for the needs of your network. If you have more than one Virtuozzo-based physical server, each one of the servers will have a similar architecture. In Virtuozzo terminology, such servers are called *Hardware Nodes* (or just *Nodes*), because they represent hardware units within a network.

Parallels Virtuozzo Containers 4.0 is installed on Red Hat Enterprise Linux 4 and 5, Fedora 7 and 8, CentOS 4 and 5, and Suse Linux Enterprise Server 10 configured in a certain way. For example, such customized configuration shall include the creation of a `/vz` partition, which is the basic partition for hosting Containers and which must be way larger than the root partition. This and similar configuration issues are most easily resolved during the Linux installation on the Hardware Node. Detailed instructions on installing Linux (called *Host Operating System*, or *Root Operating System* in the picture above) on the Hardware Node are provided in Parallels Virtuozzo Containers Installation Guide.

Virtuozzo Containers 4.0 is installed in such a way that you will be able to boot your computer either with Virtuozzo support or without it. This support is presented as “linux virtuozzo” in your boot loader and shown as *Virtuozzo Layer* in the figure above.

However, at this point you are not yet able to create Containers. A *Container* is functionally identical to an isolated standalone server, having its own IP addresses, processes, files, users, its own configuration files, its own applications, system libraries, and so on. Containers share the same *Hardware Node* and the same OS kernel. However, they are isolated from each other. A Container is a kind of ‘sandbox’ for processes and users.

Different Containers can run different versions of Linux (for example, SuSE 9.3 or Fedora 8 and many others). Each Container can run its own version of Linux. In this case we say that a Container is based on a certain OS template. OS templates are software packages shipped with Virtuozzo Containers 4.0. Before you are able to create a Container, you should install the corresponding OS template in Parallels Virtuozzo Containers. This is displayed as *Virtuozzo Templates* in the scheme above.

After you have installed at least one OS template, you can create any number of Containers with the help of standard Virtuozzo utilities, configure their network and/or other settings, and work with these Containers as with fully functional Linux servers.

Virtuozzo Configuration

Virtuozzo Containers 4.0 allows you to flexibly configure various settings for the Virtuozzo system in general as well as for each and every Container. Among these settings are disk and user quota, network parameters, default file locations and configuration sample files, and others.

Parallels Virtuozzo Containers stores the configuration information in two types of files: the global configuration file `/etc/vz/vz.conf` and Container configuration files `/etc/vz/conf/<CT_ID>.conf`. The global configuration file defines global and default parameters for Container operation, for example, logging settings, enabling and disabling disk quota for Containers, the default configuration file and OS template on the basis of which a new Container is created, and so on. On the other hand, a Container configuration file defines the parameters for a given particular Container, such as disk quota and allocated resources limits, IP address and host name, and so on. In case a parameter is configured both in the global Virtuozzo configuration file, and in the Container configuration file, the Container configuration file takes precedence. For a list of parameters constituting the global configuration file and the Container configuration files, turn to the Parallels Virtuozzo Containers Reference Guide.

The configuration files are read when The Virtuozzo Containers software and/or Containers are started. However, Virtuozzo standard utilities, for example, `vzctl`, allow you to change many configuration settings “on-the-fly”, either without modifying the corresponding configuration files or with their modification (if you want the changes to apply the next time The Virtuozzo Containers software and/or Containers are started).

Some Virtuozzo utilities have their own configuration files. For example, `vzbackup`, which is responsible for backing up Container private areas and configuration files, has its own global configuration file `/etc/vzbackup.conf` and may have a number of per-Node configuration files located in the backup directory. This directory is defined in the backup global configuration file. Both the global backup configuration file and per-Node ones are located on a central “backup” node. There are a number of other specific configuration files. All of them are detailed in the Configuring Parallels Virtuozzo Containers chapter of the Parallels Virtuozzo Containers Reference Guide.

Understanding Licensing

To start using the Virtuozzo Containers 4.0 software and Virtuozzo management tools (Parallels Management Console, Infrastructure Manager, and Power Panel), you need a special license - *Virtuozzo Server license*. You should install the Virtuozzo Server license on your server after (or while) installing Virtuozzo Containers 4.0 on it. Every Hardware Node hosting one or more Containers shall have its own license. Licenses are issued by Parallels and define a number of parameters in respect of your Node. The main licensed parameters are listed below:

- The number of CPUs which can be installed on the Hardware Node; please keep in mind that each of the Dual Core and Hyperthreading processors is regarded as one CPU.
- The number of users which can simultaneously use Parallels Management Console and Parallels Infrastructure Manager to manage the Hardware Node and its Containers.
- The license expiration date. Any license can be time-limited or permanent.

  Virtuozzo licenses have a start date and, if they are time-limited, may also have an expiration date specified in them. You shall have to set up your system clock correctly; otherwise, the license validation may fail.
- The number of Containers the Hardware Node will be able to host.
- The platform and architecture with which the Virtuozzo Containers software is compatible.
- Whether the Hardware Node can be managed by means of Parallels Infrastructure Manager.

Virtuozzo Server licenses can be shipped in one of the following ways:

- as an activation code: in this case you are provided with a special alphanumeric code which must be activated before starting to use Virtuozzo Containers 4.0 on your Hardware Node. During the activation, the code is sent to the Parallels Key Authentication (KA) server which, in its turn, verifies the code, generate a special license file, sends it back to the Node, and installs it there.
- as a product key: in this case you are provided with an alphanumeric key which is installed on your Hardware Node directly without connecting to the Parallels KA server and exchanging any information with it.

Parallels Management Console Overview

Parallels Management Console is a remote management tool for the Virtuozzo Containers software with graphical user interface. Parallels Management Console is designed for Hardware Node administrators having access to all the Containers on a particular Node. It allows the administrator to control multiple Hardware Nodes, to manage all sorts of Containers, and to monitor the system.

Parallels Management Console Specific Features

Parallels Management Console provides tools for managing any number of Hardware Nodes and Host operating systems, including the following:

- Groups of Hardware Nodes with unified space of Container IDs and IP addresses;
- Global Virtuozzo configuration parameters;
- Services of the Host OS;
- Users and groups;
- Disk usage;
- Network bandwidth usage;
- Network traffic accounting;
- Mount points;
- Firewall configuration.

Management Console facilitates major operations on all kinds of Containers such as their:

- Creating and recovering;
- Starting, stopping, and deleting;
- Backing up and restoring;
- Migrating.

Management Console also provides flexible means for managing various Container parameters, among which there are:

- Files;
- Services;
- Users and groups;
- Network settings;
- Action scripts;
- Mount points;
- Firewall configuration.

Management Console may monitor Containers as well as Hardware Nodes. It also provides access to various system logs. Alerts notify you of lack of resources or system failures.

Management Console supports all the Virtuozzo template operations, facilitating:

- Creating templates and/or template updates;
- Uploading and installing templates and/or template updates on the Hardware Node;
- Adding/removing templates and/or template updates to/from Containers.

Besides, Management Console can be used to create new VMware virtual machines and manage the existing ones.

Parallels Management Console Network Architecture

Parallels Management Console uses a typical client/server architecture. The client Management Console program runs on either Microsoft Windows 2000/XP/2003 or Linux (Fedora Core 4, 5, 6; Fedora 7 and 8; Red Hat Enterprise Linux 4 and 5; CentOS 4 and 5; SUSE Linux Enterprise Desktop 10, Ubuntu 6) workstation with X Window System.

The client application with the graphical user interface connects to the Parallels Agent software, which is running in the special Service Container on the Hardware Node. Parallels Agent communicates with the client via the well-documented open Parallels Agent XML API and controls the Hardware Node itself and Containers.

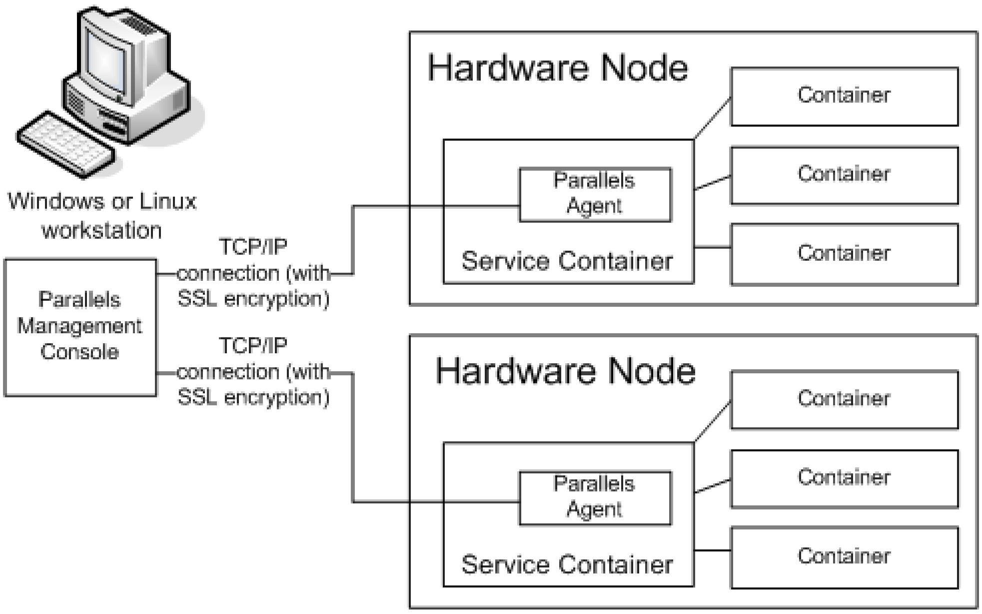

Figure 3: Management Console Network Architecture

The client may control multiple Hardware Nodes simultaneously by connecting to multiple agents as is shown in the figure above. As the communications between the client and Parallels Agents are secure, the Parallels Management Console workstation may be located virtually anywhere on the net.

Hardware Node Main Window

You will feel most comfortable with Parallels Management Console with the screen resolution of 1024x768 or higher. The main window of Management Console consists of two parts: the tree pane on the left, and view pane on the right. There is a list of Hardware Nodes in the tree pane. The Hardware Node subtree represents various aspects of its management, e.g. Services, Logs, Templates, Backups, etc. The content of the view pane depends on the selected item in the tree pane.

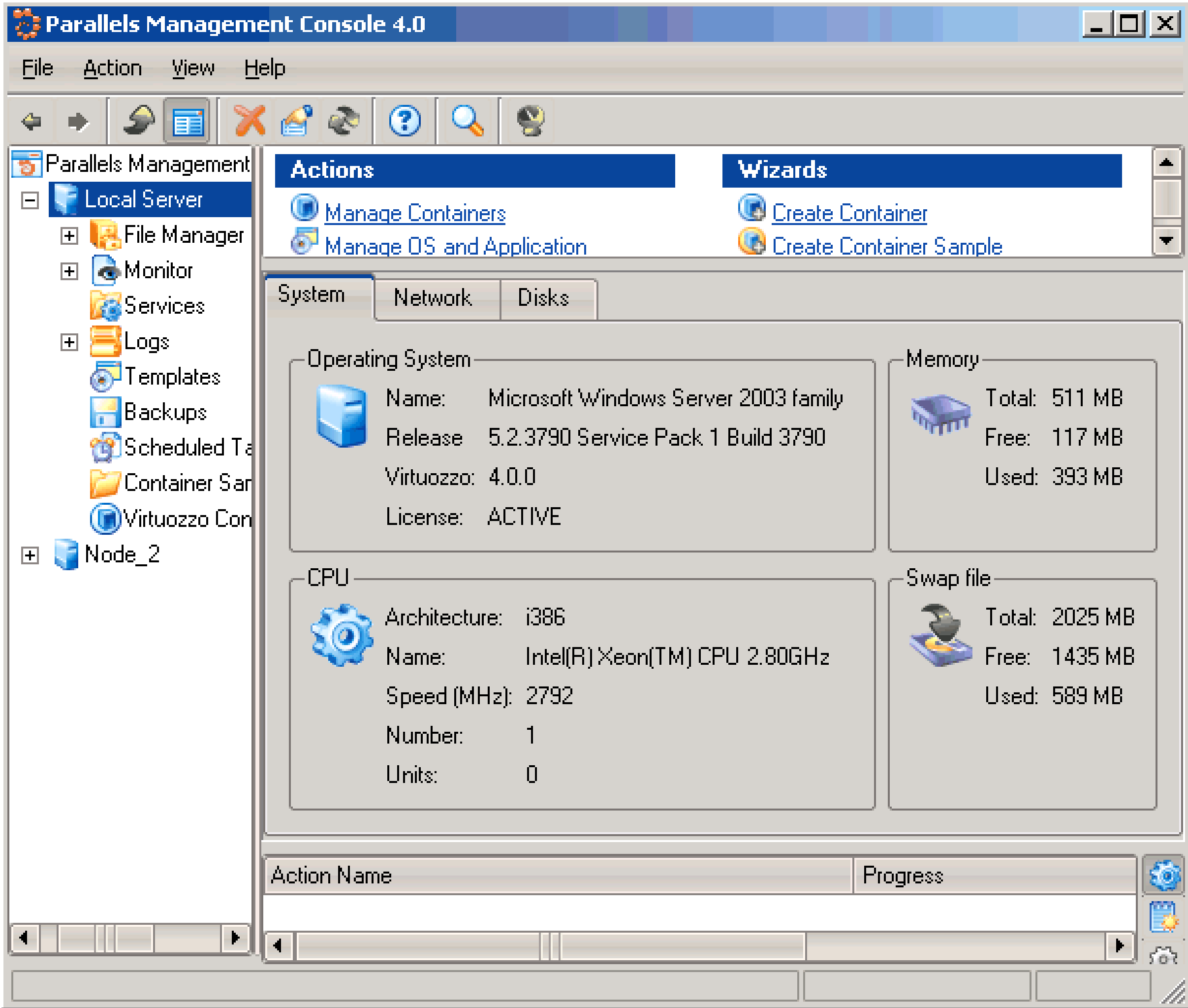

Figure 4: Management Console Main Window

Below the view pane on the right, there is also a small Actions/Messages/Operations pane. You may switch between the Actions and Messages modes by clicking buttons to the right of this pane. The Actions pane displays the progress of Management Console actions. The Messages pane displays the detailed diagnostics of various Management Console errors. The Operations pane shows the result of various asynchronous tasks performed with Containers.

You can view the summary page for every Hardware Node. Click on the name of the Hardware Node you are interested in in the tree in the left pane of the Management Console main window or double–click the name of the Hardware Node in the list of Nodes in the right pane.

The upper part of the view pane contains shortcuts to the most important tasks you are likely to do. However, all the actions and operations are accessible via the Management Console toolbar, Action menu, and context menus. The bottom part of the view pane includes three tabs: System, Network, and Disks. The System tab describes the OS distribution and kernel version, CPU(s), RAM, swap information, etc. The Network tab describes the Hardware Node network configuration: interfaces, DNSs, IP addresses, etc. The Disks tab describes disks available on the Hardware Node and their utilization.

Parallels Infrastructure Management Overview

Parallels Infrastructure Manager is designed for Hardware Node administrators and provides them with the ability to manage multiple Hardware Nodes and all Containers residing on them with the help of a standard Web browser on any platform. A list of supported browsers is given below:

- Internet Explorer 6.0 and above;
- Mozilla 1.7 and above;
- Firefox 1.0 and above;
- Opera 8.0 and above.

Chances are that you will also be able to use other browsers, but Parallels Virtuozzo Containers 4.0 has not been extensively tested with them.

The Parallels Infrastructure Manager interface has been designed to let the Virtuozzo server administrator quickly perform all possible tasks through an intuitive navigation system:

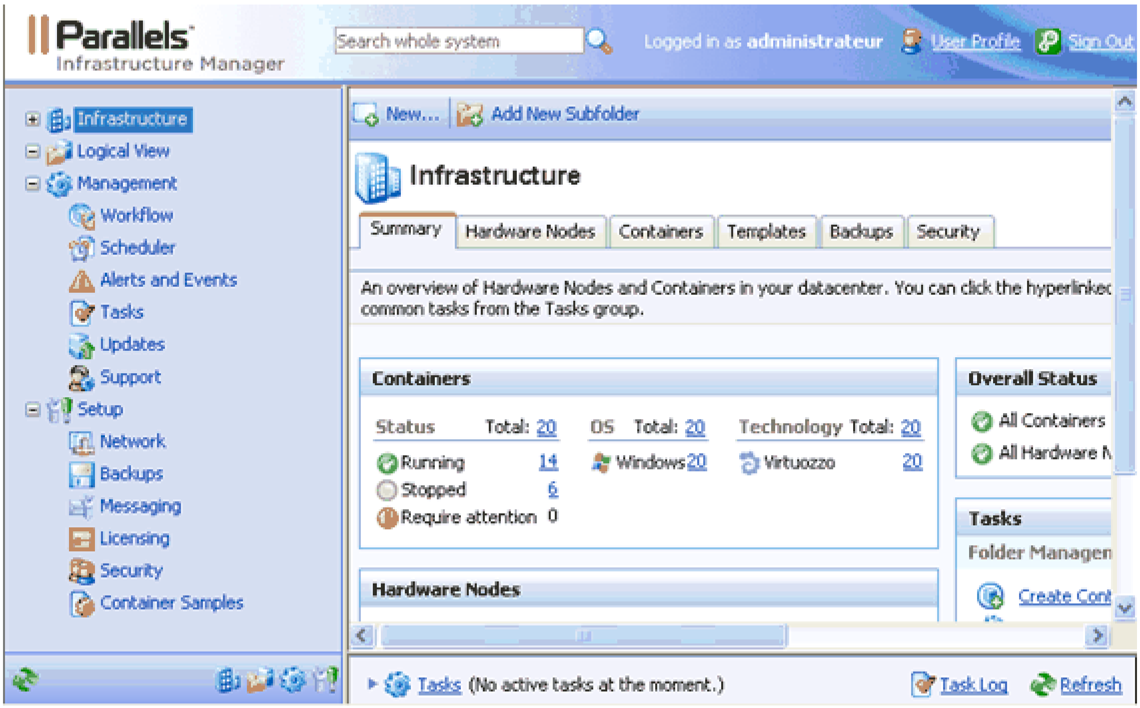

Figure 5: Infrastructure Manager Interface Overview

The main components the Parallels Infrastructure Manager interface consists of are:

- The left menu frame listing and allowing to access all your Hardware Nodes and Containers and the main types of operations to be performed on them with the help of Parallels Infrastructure Manager;
- The toolbar on top of the right frame allowing to perform on your Hardware Nodes and Containers the actions most frequently called for in your routine management work and, when necessary, a few more buttons allowing to perform additional actions on the objects listed in the content part of the right frame (Container backups, packages updates, etc.);

- The content part on the right frame displaying the currently accessed Hardware Nodes or Containers, the key information (their statuses, configuration, etc.) and links to advanced actions.

Note: Detailed information on Parallels Infrastructure Manager is given in its comprehensive online help system and Parallels Infrastructure Manager Administrator's Guide shipped with Infrastructure Manager.

Parallels Power Panel Overview

Wherever Parallels Virtuozzo Containers is applied, there are people that are supposed to be administrators of particular Containers only, with no access rights to Hardware Nodes as such. This is only but natural as it corresponds directly with the concept of a virtualization technology. Such people can be subscribers to a hosting provider, university students, or administrators of a particular server within an enterprise. Virtuozzo Containers 4.0 is equipped with a web-based tool for managing personal Containers called Parallels Power Panel.

Parallels Power Panel is a means for administering personal Containers through a common browser - Internet Explorer, Mozilla, and others. It is implemented by the `vzcp` package installed inside the Service Container during the Virtuozzo Containers installation. The `vzcpcon` process running in the Service Container handles the client browser requests and passes them to the Parallels Agent software, which is responsible for managing all the Containers of the given Hardware Node.

Parallels Power Panel allows Container administrators to:

- Start, stop, or restart the Container;
- Repair the Container;
- Reinstall the Container;
- Back up and restore the Container;
- Change the Container root password;
- Start, stop, or restart certain services inside the Container;
- Access other control panels installed in the Container, for example the Plesk control panel.
- View a list of Container processes and send them signals;
- View the current resources consumption and resources overusage alerts;
- View the Virtuozzo logs, etc.

Access rights to administer particular Containers by means of Parallels Power Panel are determined by the Hardware Node administrator. Detailed instructions on how to control access rights to particular Containers through Power Panel are provided in the Setting Virtuozzo Tools to Work chapter of the Parallels Virtuozzo Containers Installation Guide.

Note: Parallels Power Panel can also be used by the Hardware Node administrator for managing any Container on the given Node.

Hardware Node Availability Considerations

Hardware Node availability is more critical than the availability of a typical PC server. Since it runs multiple Containers providing a number of critical services, Hardware Node outage might be very costly. Hardware Node outage can be as disastrous as the simultaneous outage of a number of servers running critical services.

In order to increase Hardware Node availability, we suggest you follow the recommendations below:

- Use RAID storage for critical Container private areas. Do prefer hardware RAID, but software mirroring RAID might suit too as a last resort.
- Do not run software on the Hardware Node itself. Create special Containers where you can host necessary services such as BIND, FTPD, HTTPD, and so on. On the Hardware Node itself, you need only the SSH daemon. Preferably, it should accept connections from a pre-defined set of IP addresses only.
- Do not create users on the Hardware Node itself. You can create as many users as you need in any Container. Remember, compromising the Hardware Node means compromising all Containers as well.

CHAPTER 3

Operations on Containers

This chapter describes how to perform day-to-day operations on separate Containers taken in their wholeness.

Note: We assume that you have successfully installed, configured, and deployed your Parallels Virtuozzo system. In case you have not, please turn to the Parallels Virtuozzo Containers Installation Guide providing detailed information on all these operations.

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Creating New Container

This section guides you through the process of creating a Container. We assume that you have successfully installed Virtuozzo Containers 4.0 and prepared at least one OS EZ template. If there are no OS EZ templates prepared for the Container creation, turn to the Parallels Virtuozzo Containers Templates Management Guide first.

Before You Begin

Before you start creating a Container, you should:

- Check that the Hardware Node is visible on your network. You should be able to connect to/from other hosts. Otherwise, your Containers will not be accessible from other servers.
- Check that you have at least one IP address per Container and the addresses belong to the same network as the Hardware Node or routing to the Containers has been set up via the Hardware Node.

To create a new Container, you have to:

- choose the new Container ID;
- choose the OS template to use for the Container;
- create the Container itself.

Choosing Container ID

Every Container has a numeric ID, also known as Container ID, associated with it. The ID is a 32-bit integer number beginning with zero and unique for a given Hardware Node. When choosing an ID for your Container, please follow the simple guidelines below:

- ID 0 is used for the Hardware Node itself. You cannot and should not try to create a Container with ID 0.
- This version of Virtuozzo Containers uses ID 1 for the Service Container.

Note: The Service Container is a special Container running the Parallels Agent software responsible for managing all the Containers of the given Hardware Node via Virtuozzo tools (i.e. Parallels Management Console, Parallels Infrastructure Manager, and Parallels Power Panel). In general, you are allowed to perform the same operations in the Service Container context as you would perform in the context of a regular Container. However, you are not recommended to change the default configuration of the Service Container (e.g. install your own applications/templates into or store your private files inside this Container). Changing the Service Container configuration may affect all the other Containers residing on the Node.

- The Virtuozzo Containers software reserves the IDs ranging from 0 to 100. Though Parallels Virtuozzo Containers uses only IDs 0 and 1 from them, the next version might use additional Containers IDs for internal needs. *To facilitate upgrading, please do not create Containers with IDs below 101.*

The only strict requirement for a Container ID is to be unique for a particular Hardware Node. However, if you are going to have several computers running Virtuozzo Containers 4.0, we recommend assigning different Container ID ranges to them. For example, on Hardware Node 1 you create Containers within the range of IDs from 101 to 1000; on Hardware Node 2 you use the range from 1001 to 2000, and so on. This approach makes it easier to remember on which Hardware Node a Container has been created, and eliminates the possibility of Container ID conflicts when a Container migrates from one Hardware Node to another.

Another approach to assigning Container IDs is to follow some pattern of Container IP addresses. Thus, for example, if you have a subnet with the 10.0.x.x address range, you may want to assign the 17015 ID to the Container with the 10.0.17.15 IP address, the 39108 ID to the Container with the 10.0.39.108 IP address, and so on. This makes it much easier to run a number of Virtuozzo utilities eliminating the necessity to check up the Container IP address by its ID and similar tasks. You can also think of your own patterns for assigning Container IDs depending on the configuration of your network and your specific needs.

Before you decide on a new Container ID, you may want to make sure that no Container with this ID has yet been created on the Hardware Node. The easiest way to check whether the Container with the given ID exists is to issue the following command:

```
# vzlist -a 101
Container not found
```

This output shows that Container 101 does not exist on the particular Hardware Node; otherwise it would be present in the list.

If you use Parallels Management Console, click on the name of your Hardware Node in the left pane and then on the Virtuozzo Containers item. The Management Console right pane will display a list of existing Containers on the Node.

WARNING! When deciding on a Container ID, do not use the ID of any Container that was ever present in the system unless you are sure that no data belonging to the old Container remains on the Node. The fact is that the administrator of the newly-created Container might have access to these data in this case, i.e. to the backups of the old Container, its logs, statistics, etc.

Choosing OS EZ Template

Before starting to create a Container, you shall decide on which OS EZ template your Container will be based. There might be several OS EZ templates installed on the Hardware Node and prepared for the Container creation; use the `vzpkg list` command to find out what OS EZ templates are available on your system:

```
# vzpkg list -O
redhat-el5-x86            2007-05-21 23:59:44
fedora-core-8-x86            2007-12-11 12:45:52
```

The `-O` option passed to the `vzpkg list` command allows you to list only OS EZ templates installed on the Hardware Node. As you can see, the `redhat-el5-x86` and `fedora-core-8-x86` OS EZ templates are currently available on the Node. The time displayed beyond OS EZ templates indicates when the corresponding EZ template was cached.

You can also use the `--with-summary` option to display brief information on the installed OS EZ templates:

```
# vzpkg list -O --with-summary
redhat-el5-x86    :Red Hat Enterprise Linux v.5 Server EZ OS template
fedora-core-8-x86 :Fedora Core 8 EZ OS template
```

For complete information on the `vzpkg list` command, you can consult **Parallels Virtuozzo Containers Reference Guide**.

In Parallels Management Console, you only have to click the **Templates** item under the corresponding Hardware Node name and then the **OS Templates** tab to see a list of the installed OS EZ templates:

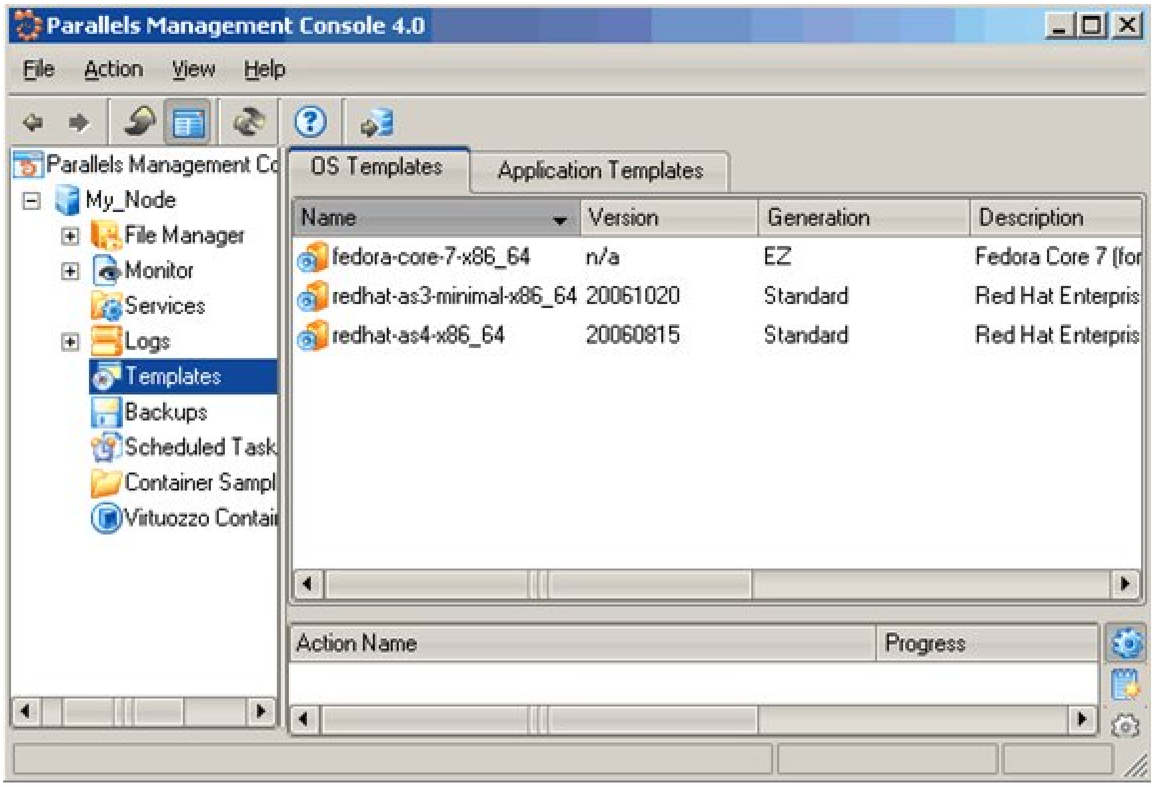

Figure 6: Management Console - Listing EZ OS Templates

OS EZ templates can be easily identified by the 'EZ' inscription displayed in the **Generation** column next to the corresponding template name.

Creating Container

After the Container ID and the installed OS EZ template have been chosen, you can create the Container private area with the `vzctl create` command. The private area is the directory containing the VZFS symlinks, copy-on-write area, and private files of the given Container. The private area is mounted to the `/vz/root/`*`CT_ID`* directory on the Hardware Node and provides Container users with a complete Linux file system tree.

The `vzctl create` command requires only the Container ID and the name of the OS template as arguments; however, in order to avoid setting all the Container resource control parameters after creating the private area, you can specify a sample configuration to be used for your new Container. The sample configuration files are residing in the `/etc/vz/conf` directory and have names with the following mask: `ve-<`*`configname`*`>.conf-sample`. The most commonly used sample is the `ve-basic.conf-sample` file; this sample file has resource control parameters suitable for most Containers.

Thus, for example, you can create a new Container by typing the following string:

```
# vzctl create 101 --ostemplate redhat-el5-x86 -–config basic
Creating Container private area (redhat-el5-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area was created
Delete port redirection
Adding port redirection to Container(1): 4643 8443
```

In this case, the Virtuozzo Containers software will create a Container with ID 101, the private area based on the `redhat-el5-x86` OS EZ template, and configuration parameters taken from the `ve-basic.conf-sample` sample configuration file.

If you specify neither an OS template nor a sample configuration, `vzctl` will try to take the corresponding values from the global Virtuozzo configuration file (`/etc/vz/vz.conf`). So you can set the default values in this file using your favorite text file editor, for example:

```
DEF_OSTEMPLATE=".redhat-el5-x86"
CONFIGFILE="basic"
```

and do without specifying these parameters each time you create a new Container. Please keep in mind that the `.` symbol before the template name in the `DEF_OSTEMPLATE` parameter is used to indicate that the Container being created is to be based on an OS EZ template; otherwise, it will denote an OS standard template (detailed information on OS standard templates and how to create Containers on the basis of these templates is provided in the Parallels Virtuozzo Containers Templates Management Guide).

Now you can create a Container with ID 101 with the following command:

```
# vzctl create 101
Creating Container private area (redhat-el5-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area was created
Delete port redirection
Adding port redirection to Container(1): 4643 8443
```

In principle, now you are ready to start your newly created Container. However, typically you need to set its network IP address, hostname, DNS server address and `root` password before starting the Container for the first time.

Creating Containers in Parallels Management Console

Parallels Management Console uses one wizard both to create a Container and to initially configure it. You can launch this wizard by selecting the Virtuozzo Containers item in the left pane and choosing the Create Container option on the Action menu:

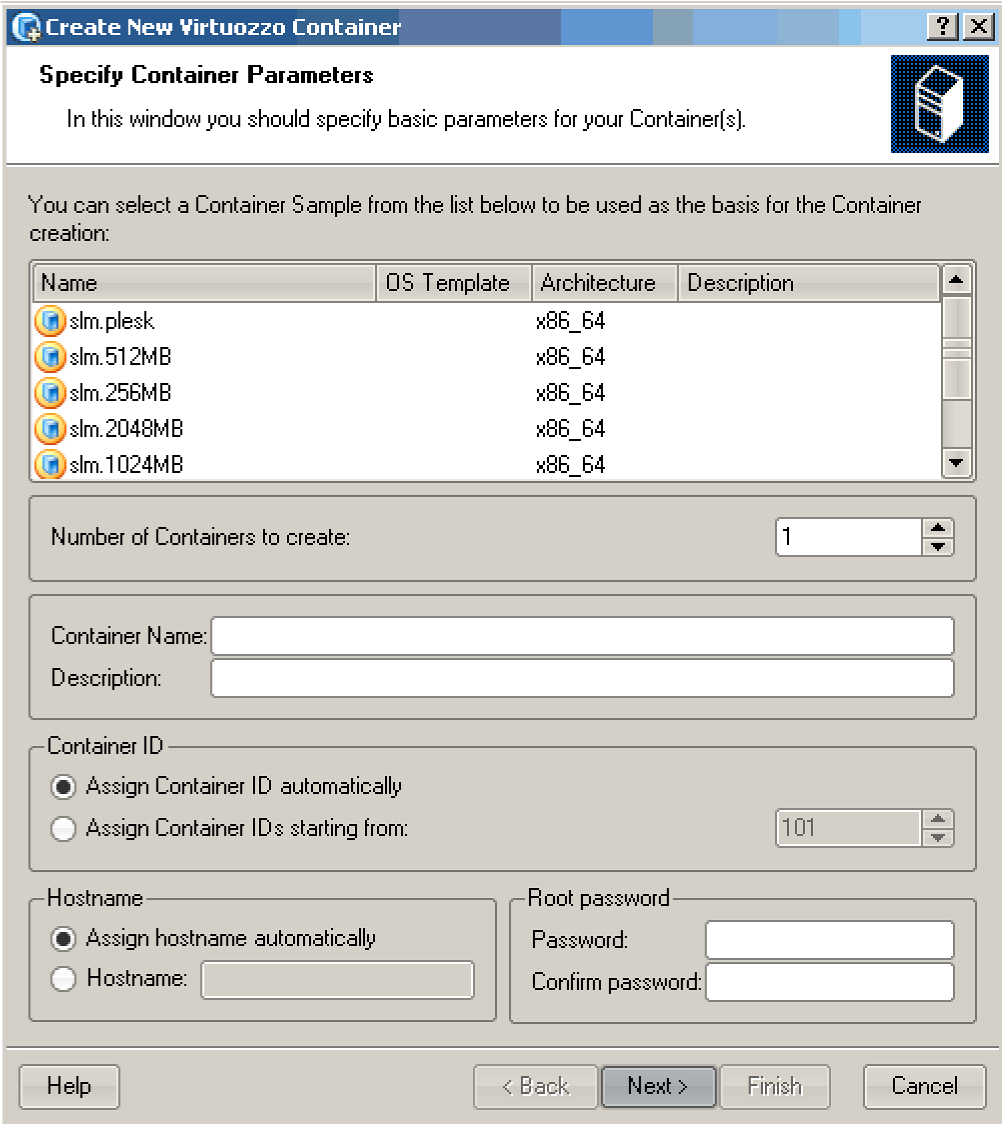

Figure 7: Management Console - Creating New Container

The main Container parameters, including the templates and resource management parameters, can be retrieved on the basis of the Container configuration sample indicated in the very first option (detailed information on Container configuration samples is provided in the Managing Container Resources Configurations section (p. 158)).

After you have decided on the Container configuration sample, you are supposed to define the number of Containers you wish to create in the Number of Containers to create field. By default, you are offered to create one Container. Besides, you can:

- specify a name for your Container(s) in the **Containers Name** field; this name can then be used, along with the Container ID, to refer to the Container while performing this or that Container-related operation on the Hardware Node. In the case of creating several Containers at once, you should use the `$VEID` placeholder which is automatically replaced with the ID of the Container being created. For example, if you are creating Containers in the range from 101 to 103 and enter `MyCT$VEID` into the Container Name(s) field, your Containers will have the following names: `MyCT101`, `MyCT102`, `MyCT103`.
- provide the description of the Container(s) in the **Description** field. You may enter any Container-related information you consider reasonable.

Under the **Container ID** group, you can select the variant the Container ID assignment:

- Select the **Assign Container ID automatically** radio button to automatically assign the first unoccupied ID to the Container. For example, if you already have Containers with IDs from 101 through 105 and 107, the Container will be assigned the ID of 106.
- Select the **Assign Container IDs starting from** radio button to manually specify the ID to be assigned to the Container. If you are creating several Containers at once, the specified ID will denote the starting ID for the first created Container. For example, if you are making 2 Containers and indicate 110 in the field provided, the first Container will be assigned the ID of 110 and the second one - the ID of 111 (provided you do not already have Containers with such IDs).

The **Hostname** group of options on the first page of the wizard shown above might help you make use of your DNS server. If your DNS server has records for the IP addresses that will be assigned to the newly-created Containers, select the **Assign hostname automatically** radio button. The hostnames will be assigned on the basis of DNS records found. Selecting the **Hostname** radio button allows you to manually set a hostname for the Container. As in the case of assigning names to your Containers, you should use the `$VEID` placeholder if you are creating several Containers at once. This placeholder is then automatically replaced with the ID of the Container being created.

By default, the root account is disabled in a newly-created Container. To enable this account, you may enter the root password on the first page of the wizard. If you leave the **Password** and **Confirm password** fields blank, the root account will remain disabled.

Clicking the **Next** button displays the window where you can specify the settings for Container virtual network adapters:

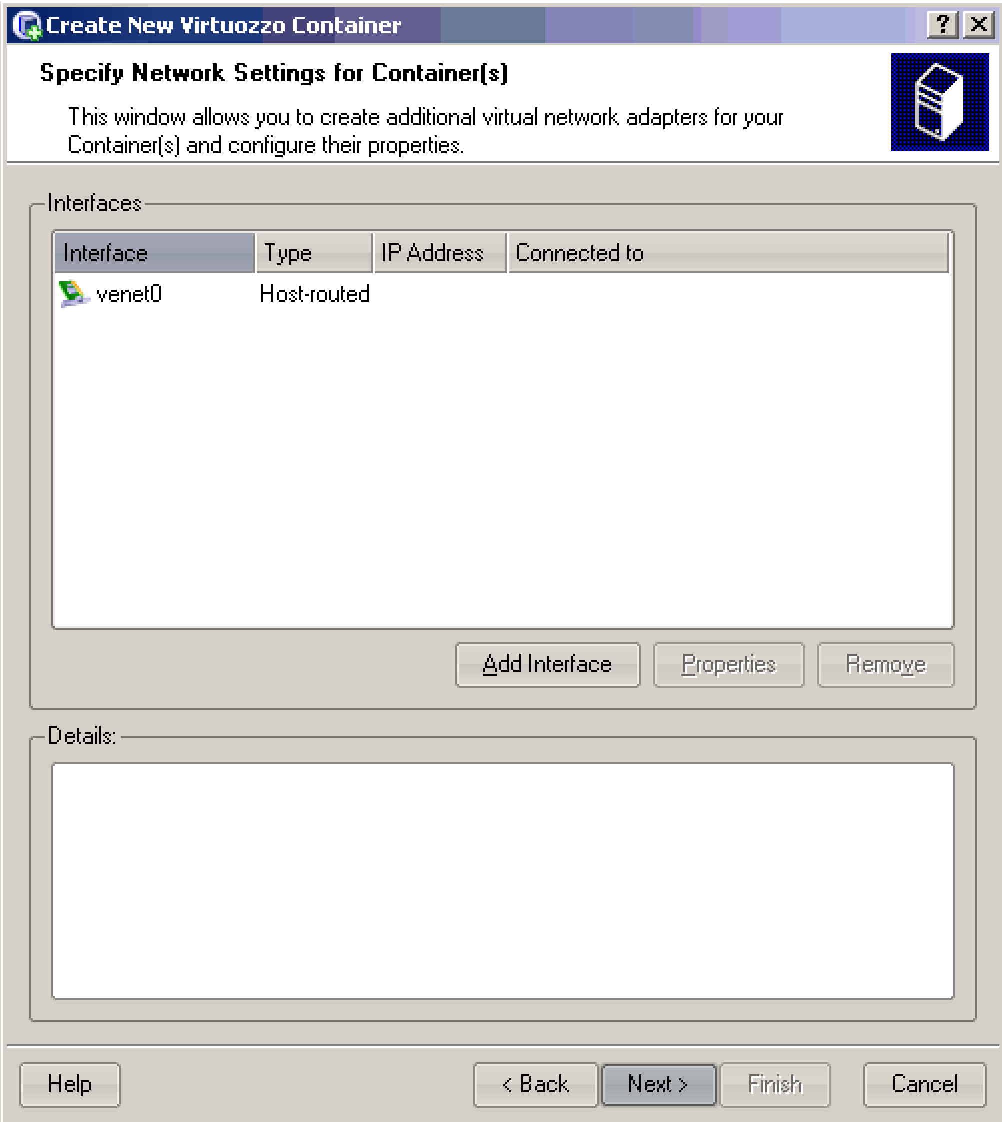

Figure 8: Management Console - Configuring Container Network Adapters

This window allows you to:

- Assign one or more IP addresses to the `venet0` virtual network adapter which is the default adapter created for every Container on the Hardware Node. To this effect, select the adapter name, click the **Properties** button, and, in the displayed window, enter the needed IP addresses.
- Create additional virtual network adapters for the Container by clicking the **Add Interface** button and entering the necessary information in the displayed window. As distinct from the default adapter operating in the host-routed mode, all additional network adapters are set to work in the bridged mode. For detailed information on what host-routed and bridged modes are and how to manage virtual network adapters operating in these modes, please turn to the **Managing Virtuozzo Network** chapter (p. 205).

On the next step, you should choose the OS template to be used as the basis for the Container creation:

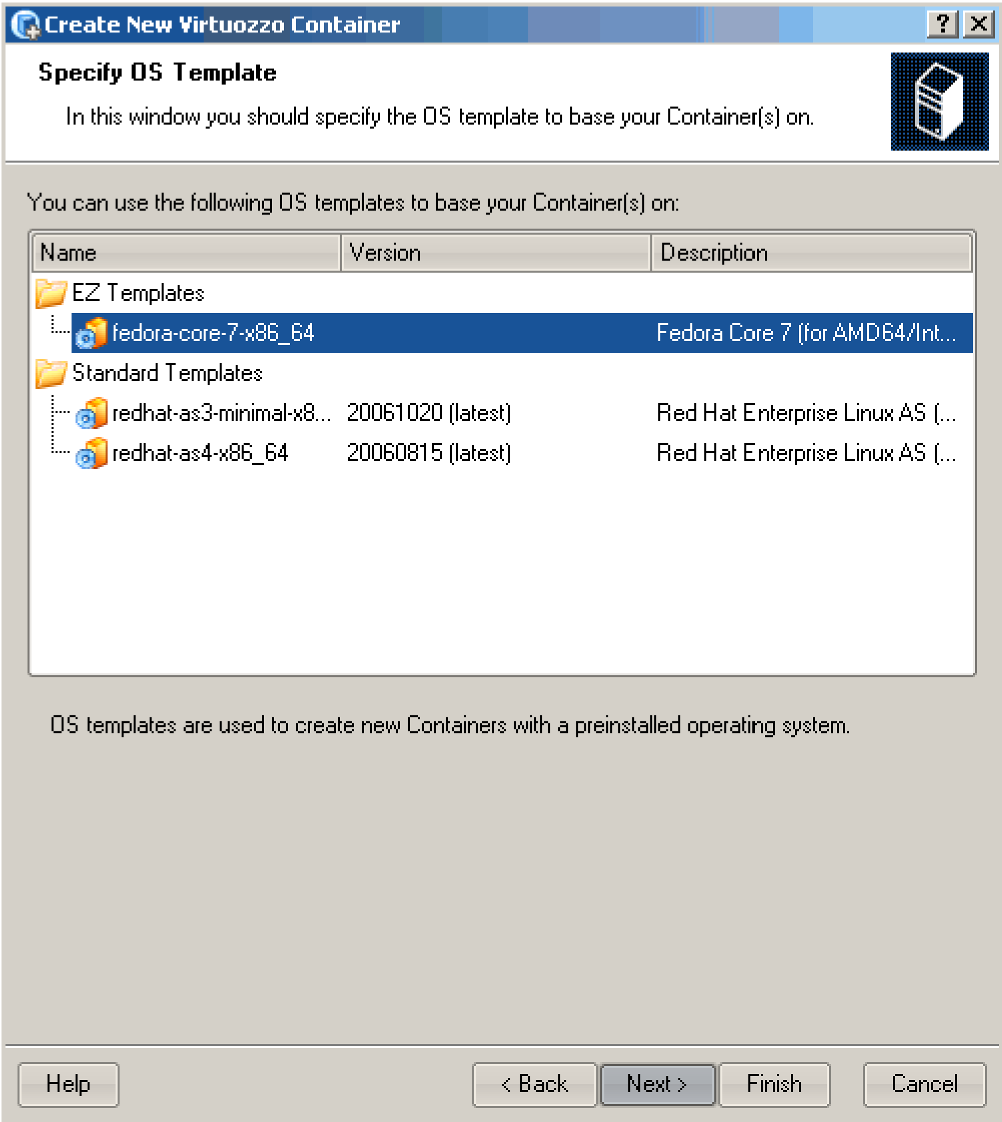

Figure 9: Management Console - Choosing OS Template

All OS templates that are installed on the Hardware Node and can be used for the Container creation are listed in the table on the **Specify OS Template** screen. To choose an OS template, click its name in the **Name** column. Detailed information on OS templates is provided in the **Parallels Virtuozzo Containers Template Management Guide** shipped with Virtuozzo Containers 4.0.

You can click on the **Finish** button on this step of the wizard and create the Container with the configuration parameters specified in the configuration sample you chose on the first step of the wizard. If you do not rely on any configuration sample, click the **Next** button instead of **Finish**. In this case you will have to go through a number of steps of the wizard and set all the parameters of the new Container separately. However, you can click **Finish** on every of the following steps of the wizard to start creating the Container. All the pages of the wizard are self-explanatory, so there is no need in dwelling upon them here in detail. You have the possibility to:

- Choose the OS template as the Container base and the application templates to be added to the Containers. Detailed information on OS and application templates is provided in the Parallels Virtuozzo Containers Templates Management Guide shipped with Virtuozzo Containers 4.0.
- Change the default Container private area and root paths or leave them intact.
- Specify one or more search domains and DNS servers and decide on the default gateway to be used by the `venet0` default network adapter.
- Configure Quality of Service parameters. The Quality of Service parameters are explained in the Managing Resources chapter (p. 116); please consult it to gather more understanding of this topic.
- Enable the offline management for the Container for it to be directly managed by its root from any browser at the Container IP address. For information on the offline management feature, please see the Configuring Offline Management Parameters section.
- Configure network shaping parameters. For detailed information on network shaping, please turn to the Managing Network Accounting and Bandwidth section (p. 142).
- Define what `iptables` modules are to be used inside the Container. Detailed information on `iptables` is provided in the Loading iptables Modules section (p. 339).
- Specify whether the Container is to be started on the Hardware Node boot.
- Save all the defined parameters as a configuration sample file to be used in future for creating new Containers on its basis. The information on Container samples is provided in the Managing Container Resources Configuration section (p. 158). Please consult it to gather more understanding of these topics.

Creating a new Container may take some time. You can see the progress in the Actions pane.

After you have created, for example, Containers 101, 102, and 103, you can see them in the right pane of the Management Console window:

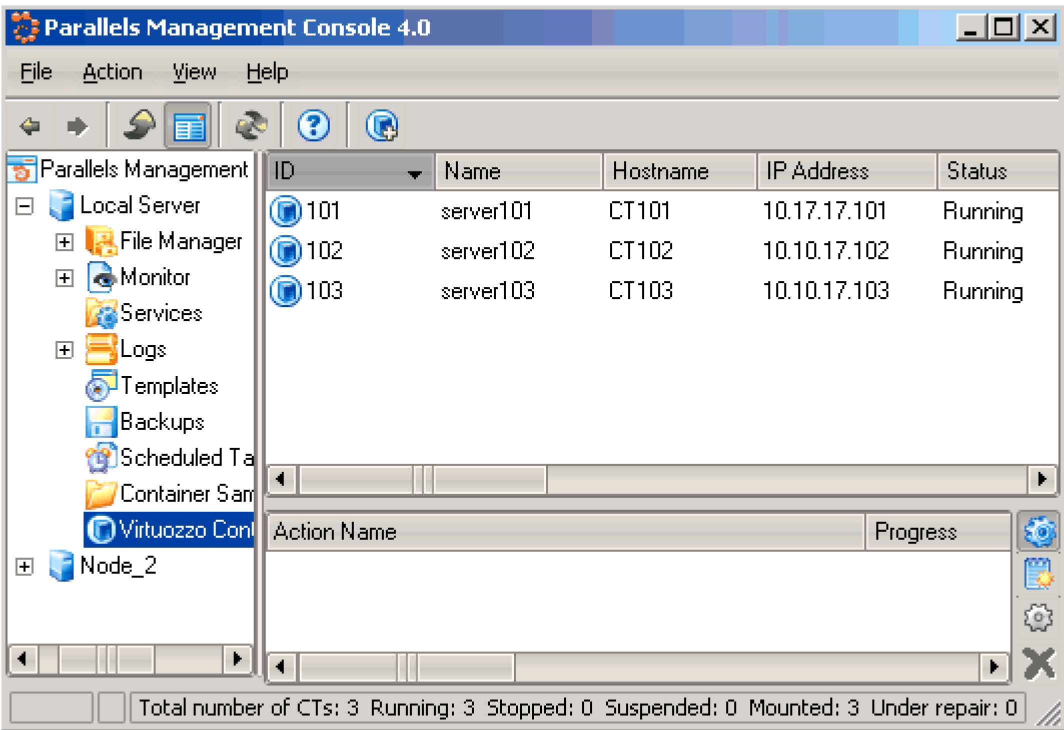

Figure 10: Management Console - Checking Newly-Created Container

Select any of the newly-created Container and choose the Properties item on the Action menu (or use the context menu, if you like). You will have the possibility to review and/or change most of the configuration options for this Container, as well as to set the root password using the Advanced tab.

Configuring Container

Configuring a Container consists of several tasks:

- Setting Container startup parameters;
- Setting Container network parameters;
- Setting Container user passwords;
- Configuring Quality of Service (Service Level) parameters.

For all these tasks, the `vzctl set` command is used. Using this command for setting Container startup parameters, network parameters, and user passwords is explained later in this subsection. Service Level Management configuration topics are dwelled upon in the Managing Resources chapter (p. 116).

Setting Startup Parameters

The `vzctl set` command allows you to define the `onboot` Container startup parameter. Setting this parameter to `yes` makes your Container automatically boot at the Hardware Node startup. For example, to enable Container 101 to automatically start on your Hardware Node boot, you can execute the following command:

```
# vzctl set 101 --onboot yes --save
Saved parameters for Container 101
```

The `onboot` parameter will have effect only on the next Container startup.

Setting Network Parameters

In order to be accessible from the network, a Container shall be assigned a correct IP address and hostname; DNS servers shall also be configured. In addition, the SSH or Telnet daemon shall be running inside the Container. The session below illustrates setting the Container 101 network parameters:

```
# vzctl set 101 --hostname server101.parallels.com --save
Hostname for Container set: server101.parallels.com
Saved parameters for Container 101
# vzctl set 101 --ipadd 10.0.186.1 --save
Adding IP address(es): 10.0.186.1
Saved parameters for Container 101
# vzctl set 101 --nameserver 192.168.1.165 --save
File resolv.conf was modified
Saved parameters for Container 101
```

This command will assign Container 101 the IP address of 10.0.186.1, the hostname of `server101.parallels.com`, and set the DNS server address to 192.168.1.165. The `--save` flag saves all the parameters to the Container configuration file.

You can issue the above commands when the Container is running. In this case, if you do not want the applied values to persist, you can omit the `--save` option and the applied values will be valid only until the Container shutdown.

To check whether SSH is running inside the Container, use `vzctl exec`, which allows executing any commands in the Container context. In Red Hat 9 and other new OS templates, `sshd` is dependent on `xinetd`, so run:

```
# vzctl start 101
[This command starts Container 101, if it is not started yet]
# vzctl exec 101 service xinetd status
xinetd is stopped
# vzctl exec 101 service xinetd start
Starting xinetd: [  OK  ]
# vzctl exec 101 service xinetd status
xinetd is started
```

The above example assumes that Container 101 is created on the Red Hat Linux template. For other OS templates, please consult the corresponding OS documentation.

For more information on running commands inside a Container from the Hardware Node, see the Running Commands in Container subsection (p. 115).

Setting root Password for Container

Setting the `root` user password is necessary for connecting to a Container via SSH or Parallels Power Panel. By default, the `root` account is locked in a newly created Container, and you cannot log in. In order to log in to the Container, it is necessary to create a user account inside the Container and set a password for this account or unlock the `root` account. The easiest way of doing it is to run:

```
# vzctl start 101
[This command starts Container 101, if it is not started yet]
# vzctl set 101 --userpasswd root:test
```

In this example, we set the root password for Container 101 to "test", and you can log in to the Container via SSH as root and administer it in the same way as you administer a standalone Linux server: install additional software, add users, set up services, and so on. The password will be set inside the Container in the `/etc/shadow` file in an encrypted form and will not be stored in the Container configuration file. Therefore, if you forget the password, you have to reset it. Note that `--userpasswd` does not requires the `--save` switch, the password is anyway persistently set for the given Container.

While you can create users and set passwords for them using the `vzctl exec` or `vzctl set` commands, it is suggested that you delegate user management to the Container administrator advising him/her of the Container `root` account password.

Starting, Stopping, Restarting, and Querying Status of Container

When a Container is created, it may be started up and shut down like an ordinary server. To start Container 101, use the following command:

```
# vzctl start 101
Starting Container ...
Container is mounted
Adding port redirection to Container(1): 4643 8443
Adding IP address(es): 10.0.186.101
Hostname for Container 101 set: test.parallels.com
Container start in progress...
```

To check the status of a Container, use the `vzctl status` command:

```
# vzctl status 101
VEID 101 exist mounted running
```

Its output shows the following information:

- Whether the Container private area exists;
- Whether this private area is mounted;
- Whether the Container is running.

In our case, `vzctl` reports that Container 101 exists, its private area is mounted, and the Container is running. Alternatively, you can make use of the `vzlist` utility:

```
# vzlist 101
CTID       NPROC STATUS  IP_ADDR         HOSTNAME
 101          20 running 10.0.186.101     test.parallels.com
```

Still another way of getting the Container status is checking the `/proc/vz/veinfo` file. This file lists all the Containers currently running on the Hardware Node. Each line presents a running Container in the *<CT_ID>* *<CT_class>* *<number_of_processes>* *<IP_address>* format:

```
# cat /proc/vz/veinfo
       101     2    20   10.0.186.101
         0     0    48
```

This output shows that Container 101 is running, its class ID is “2”, i.e. unlimited, there are 20 running processes inside the Container, and its IP address is 10.0.186.101. The second line corresponds to the Container with ID 0, which is the Hardware Node itself.

The following command is used to stop a Container:

```
# vzctl stop 101
Stopping Container ...
Container was stopped
Container is unmounted
# vzctl status 101
VEID 101 exist unmounted down
```

`vzctl` has a two-minute timeout for the Container shutdown scripts to be executed. If the Container is not stopped in two minutes, the system forcibly kills all the processes in the Container. The Container will be stopped in any case, even if it is seriously damaged. To avoid waiting for two minutes in case of a Container that is known to be corrupt, you may use the `--fast` switch:

```
# vzctl stop 101 --fast
Stopping Container ...
Container was stopped
Container is unmounted
```

Make sure that you do not use the `--fast` switch with healthy Containers, unless necessary, as the forcible killing of Container processes may be potentially dangerous.

The `vzctl start` and `vzctl stop` commands initiate the normal Linux OS startup or shutdown sequences inside the Container. In case of a Red Hat-like distribution, System V initialization scripts will be executed just like on an ordinary server. You can customize startup scripts inside the Container as needed.

To restart a Container, you may as well use the `vzctl restart` command:

```
# vzctl restart 101
Stopping Container ...
Container was stopped
Container is unmounted
Starting Container ...
Container is mounted
Adding IP address(es): 10.0.186.101
Container start in progress...
```

Note: You can also use Container names to start, stop, and restart the corresponding Containers. For detailed information on Container names, please turn to the Setting Name for Container section (p. 54).

Listing Containers

Very often you may want to get an overview of the Containers existing on the given Hardware Node and to get additional information about them - their IP addresses, hostnames, current resource consumption, etc. In the most general case, you may get a list of all Containers by issuing the following command:

```
# vzlist -a
      CTID      NPROC STATUS  IP_ADDR         HOSTNAME
         1        135 running 10.101.60.79    localhost
       101          8 running 10.101.66.1     ct101.parallels.com
       102          7 running 10.101.66.159   ct102.parallels.com
       103          - stopped 10.101.66.103   ct103.parallels.com
```

The `-a` switch tells the `vzlist` utility to output both running and stopped Containers. By default, only running Containers are shown. The default columns inform you of the Container IDs, the number of running processes inside Containers, their status, IP addresses, and hostnames. This output may be customized as desired by using `vzlist` command line switches. For example:

```
# vzlist -o veid,diskinodes.s -s diskinodes.s
     CTID  DQINODES.S
        1     400000
      101     200000
      102     200000
```

This shows only running Containers with the information about their IDs and soft limit on disk inodes (see the Managing UBC Resources in Parallels Virtuozzo Containers guide for more information), with the list sorted by this soft limit. The full list of the `vzlist` command line switches and output and sorting options is available in the Parallels Virtuozzo Containers Reference Guide.

Very often you may want to get an overview of the Containers existing on the given Hardware Node and to get additional information about them - their IP addresses, hostnames, status, etc. In Parallels Management Console, you may display a list of all Containers by clicking the Virtuozzo Containers item:

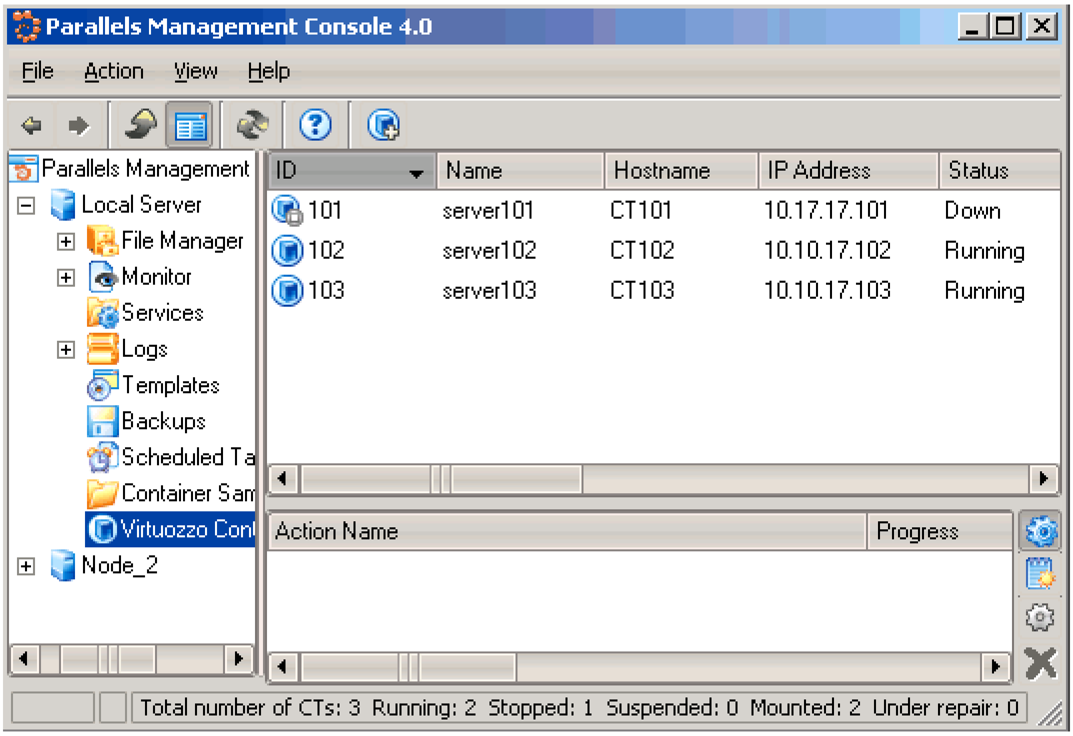

Figure 11: Management Console - Listing Containers

You can see that currently Containers 101, 102, and 103 exist on the Hardware Node. All the Container vital information (its IP address(es), hostname, statuses, etc.) is presented in the table having the following columns:

Column Name	Description
ID	The ID assigned to the Container.
Name	The name assigned to the Container. This name can be used, along with the Container ID, to perform Container-related operations on the Hardware Node.
Hostname	The hostname of the Container.
IP Address	The IP address assigned to the Container.
Status	The current status of the Container.

Resources	The circle opposite the corresponding Container reflects the current state of the resource parameters consumed by the Container: ▪ If the resource consumption lies within 90% of the limits defined for the Container, the green circle with a white tick is displayed. It means that the Container experiences no shortage in resources required for the normal course of work. ▪ If the Container consumes between 90% and 100% of the limits defined for it, the orange circle with a white exclamation mark is displayed. ▪ If the Container is currently consuming 100% or more of the limits defined for it, the red circle with a white exclamation mark is displayed. A Container is allowed to consume more than 100% of its quota only in extreme situations. If you do not solve the problem in a reasonable time, applications running inside the Container may be denied some of the resources, so application crashes and other problems are most probable.
OS	The OS template the Container is based on.
Architecture	The system architecture of the Container.
Original Sample	The name of the configuration sample the Container is based on.
Description	The Container description.

To facilitate working with Containers, you can sort them by different parameters listed in the table above: their ID, type, hostname, status, IP address, etc. Just click the column with the appropriate name to put Containers in the desired order.

Setting Name for Container

You can assign an arbitrary name to your Container and use it, along with the Container ID, to refer to the Container while performing this or that Container-related operation on the Hardware Node. For example, you can start or stop a Container by specifying the Container name instead of its ID.

You can assign names to your Containers using the `--name` option of the `vzctl set` command. For example, to set the `computer1` name for Container 101, you should execute the following command:

```
# vzctl set 101 --name computer1 --save
Name computer1 assigned
Saved parameters for Container 101
```

You can also set a name for Container 101 by editing its configuration file. In this case you should proceed as follows:

1 Open the configuration file of Container 101 (`/etc/vz/conf/101.conf`) for editing and add the following string to the file:

```
NAME="computer1"
```

2 In the `/etc/vz/names` directory on the Hardware Node, create a symbolic link with the name of `computer1` pointing to the Container configuration file. For example:

```
# ln --symbolic /etc/vz/conf/101.conf /etc/vz/names/computer1
```

When specifying names for Containers, please keep in mind the following:

- Names may contain the following symbols: `a-z`, `A-Z`, `0-9`, underscores (_), dashes (`-`), spaces, the symbols from the ASCII character table with their code in the 128 - 255 range, and all the national alphabets included in the Unicode code space.
- Container names cannot consist of digits only; otherwise, there would be no way to distinguish them from Container IDs.
- If it contains one or more spaces, the Container name should be put in single or double quotes.

After the name has been successfully assigned to Container 101, you can start using it instead of ID 101 to perform Container-related operations on the Node. For example:

- You can stop Container 101 with the following command:

```
# vzctl stop computer1
Stopping Container ...
Container was stopped
Container is unmounted
```

- You can start Container 101 anew by issuing the following command:

```
# vzctl start computer1
Starting Container ...
...
```

You can find out what name is assigned to Container 101 in one of the following ways:

- Using the `vzlist` utility:

```
# vzlist -o name 101
NAME
computer1
```

- Checking the `NAME` parameter in the Container configuration file (`/etc/vz/conf/101.conf`). For example:

```
# grep NAME /etc/vz/conf/101.conf
NAME="computer1"
```

- Checking the `NAME` parameter in the `/etc/vz/names/computer1` file which is a symlink to the Container configuration file. For example:

```
# grep NAME /etc/vz/names/computer1
NAME="computer1"
```

You can also use Parallels Management Console to set names for Containers. To this effect:

1 Choose the **Virtuozzo Containers** item under the corresponding Hardware Node, right-click the Container to which you wish to assign a name, and select **Properties** on the context menu.

2 On the **General** tab of the displayed window, enter an arbitrary name in the **Name** field.

3 Click **OK**.

Storing Extended Information on Container

Sometimes, it may be difficult to remember the information on certain Containers. The probability of this increases together with the number of Containers and with the time elapsed since the Container creation. The Virtuozzo Containers software allows you to set the description of any Container on the Hardware Node and view it later on, if required. The description can be any text containing any Container-related information; for example, you can include the following in the Container description:

- the owner of the Container;
- the purpose of the Container;
- the summary description of the Container;
- etc.

Let us assume that you are asked to create a Container for a Mr. Johnson who is going to use it for hosting the MySQL server. So, you create Container 101 and, after that, execute the following command on the Hardware Node:

```
# vzctl set 101 --description "Container 101
> owner - Mr. Johnson
> purpose - hosting the MySQL server" --save
Saved parameters for Container 101
```

This command saves the following information related to the Container: its ID, owner, and the purpose of its creation. At any time, you can display this information by issuing the following command:

```
# vzlist -o description 101
DESCRIPTION
Container 101
owner - Mr. Johnson
purpose - hosting the MySQL server
```

You can also view the Container description by checking the `DESCRIPTION` parameter of the Container configuration file (`/etc/vz/conf/101.conf`). However, the data stored in this file are more suitable for parsing by the `vzlist` command rather than for viewing by a human since all symbols in the `DESCRIPTION` field except the alphanumerical ones ('a-z', 'A-Z', and '0-9'), underscores ('_'), and dots ('.') are transformed to the corresponding hex character code.

While working with Container descriptions, please keep in mind the following:

- You can use any symbols you like in the Container description (new lines, dashes, underscores, spaces, etc.).
- If the Container description contains one or more spaces or line breaks (as in the example above), it should be put in single or double quotes.
- As distinct from a Container name, a Container description cannot be used for performing Container-related operations (e.g. for starting or stopping a Container) and is meant for reference purposes only.

To provide a description for a Container in Management Console, you should perform the following operations:

1 Choose the **Virtuozzo Containers** item under the corresponding Hardware Node, right-click the Container for which you wish to set the description, and select **Properties** on the context menu.

2 On the **General** tab of the displayed window, type the necessary information in the **Description** field.

3 Click **OK**.

Migrating Container

The Virtuozzo Hardware Node is the system with higher availability requirements in comparison with a typical Linux system. If you are running your company mail server, file server, and web server in different Containers on one and the same Hardware Node, then shutting it down for hardware upgrade will make all these services unavailable at once. To facilitate hardware upgrades and load balancing between several Hardware Nodes, the Virtuozzo Containers software provides you with the ability to migrate Containers from one physical box to another.

Migrating Containers is possible if Parallels Virtuozzo Containers for Linux is installed on two or more Hardware Nodes, so you are able to move a Container to another Node. Migration may be necessary if a Hardware Node is undergoing a planned maintenance or in certain other cases. In Virtuozzo Containers 4.0, you can choose one of the following ways to migrate a Container:

- Migrating a Container using the standard migration technology. In this case there is a short downtime needed to stop and start the Container during its migration from the Source Node to the Destination Node.
- Migrating a Container using the zero downtime migration technology. In this case the 'stop' and 'start' operations are not performed and the migrated Container is restored on the Destination Node in the same state as it was at the beginning of the migration. This greatly reduces the migration time and puts it on the same footing as the delay caused by a short interruption in the network connectivity.

Both ways are described in the following subsections in detail.

Note: Containers created under the Virtuozzo Containers 32-bit version can be migrated to Hardware Nodes running the Virtuozzo Containers 64-bit version for the x86-64 processors and cannot be moved to Hardware Nodes running the Virtuozzo Containers 64-bit version for the IA-64 processors. Moreover, you can migrate Containers created under the corresponding Virtuozzo Containers 64-bit version to Nodes running the same Virtuozzo Containers version for 64-bit processors.

Standard Migration

The standard migration procedure allows you to move both stopped and running Containers. Migrating a stopped Container includes copying all Container private files from one Node to another and does not differ from copying a number of files from one server to another over the network. In its turn, the migration procedure of a running Container is a bit more complicated and may be described as follows:

1 After initiating the migration process, all Container private data are copied to the Destination Node. During this time, the Container on the Source Node continues running.
2 The Container on the Source Node is stopped.
3 The Container private data copied to the Destination Node are compared with those on the Source Node and, if any files were changed during the first migration step, they are copied to the Destination Node again and rewrite the outdated versions.
4 The Container on the Destination Node is started.

There is a short downtime needed to stop the Container on the Source Node, copy the Container private data changes to the Destination Node, and start the Container on the Destination Node. However, this time is very short and does not usually exceed one minute.

Note: Before the migration, it might be necessary to detach the Container from its caches. For more information on cached files, see the Cleaning Up Containers subsection (p. 132).

The following session moves Container 101 from the current Hardware Node to a new one named `ts7.parallels.com`:

```
# vzmigrate ts7.parallels.com 101
root@ts7.parallels.com's password:
vzmsrc: Connection to destination Hardware Node (ts7.parallels.com) \
is successfully established
vzmsrc: Moving/copying Container#101 -> Container#101, [], [] ...
vzmsrc: Container migrating mode : first stage sync, with tracking, \
second stage sync, with Container stopping
vzmsrc: Syncing private area of Container#101 [/vz/private/101] ...
 / 100% |*****************************|
vzmsrc: done
vzmsrc: Stopping Container#101 ...
vzmsrc: done
vzmsrc: Fast syncing private area of Container#101 [/vz/private/101] ...
 / 100% |*****************************|
vzmsrc: done
vzmsrc: DST: Starting Container#101 ...
vzmsrc: DST: done
vzmsrc: Successfully completed
```

You can specify more than one Container ID simultaneously; in this case, all specified Containers will be moved to a new Hardware Node one by one.

Important! For the command to be successful, a direct SSH connection (on port 22) should be allowed between the Source and Destination Nodes.

By default, after the migration process is completed, the Container private area and configuration file are renamed on the Source Node by receiving the `.migrated` suffix. However, if you wish the Container private area on the Source Node to be removed after the successful Container migration, you can override the default `vzmigrate` behavior by changing the value of the `REMOVEMIGRATED` variable in the Virtuozzo global configuration file (`/etc/vz/vz.conf`) to "yes" or by using the `–r yes` switch of the `vzmigrate` command.

To migrate one or more Containers to another Hardware Node with Parallels Virtuozzo Containers for Linux using Parallels Management Console, select these Containers from the list in the right pane after selecting the **Virtuozzo Containers** item in the left pane. Then right-click the selection and point to **Tasks** --> **Migrate to Another Hardware Node** on the context menu. Note that the target Hardware Node must be already registered in Management Console; otherwise, the migration option will not be available. A migration dialog appears, for example:

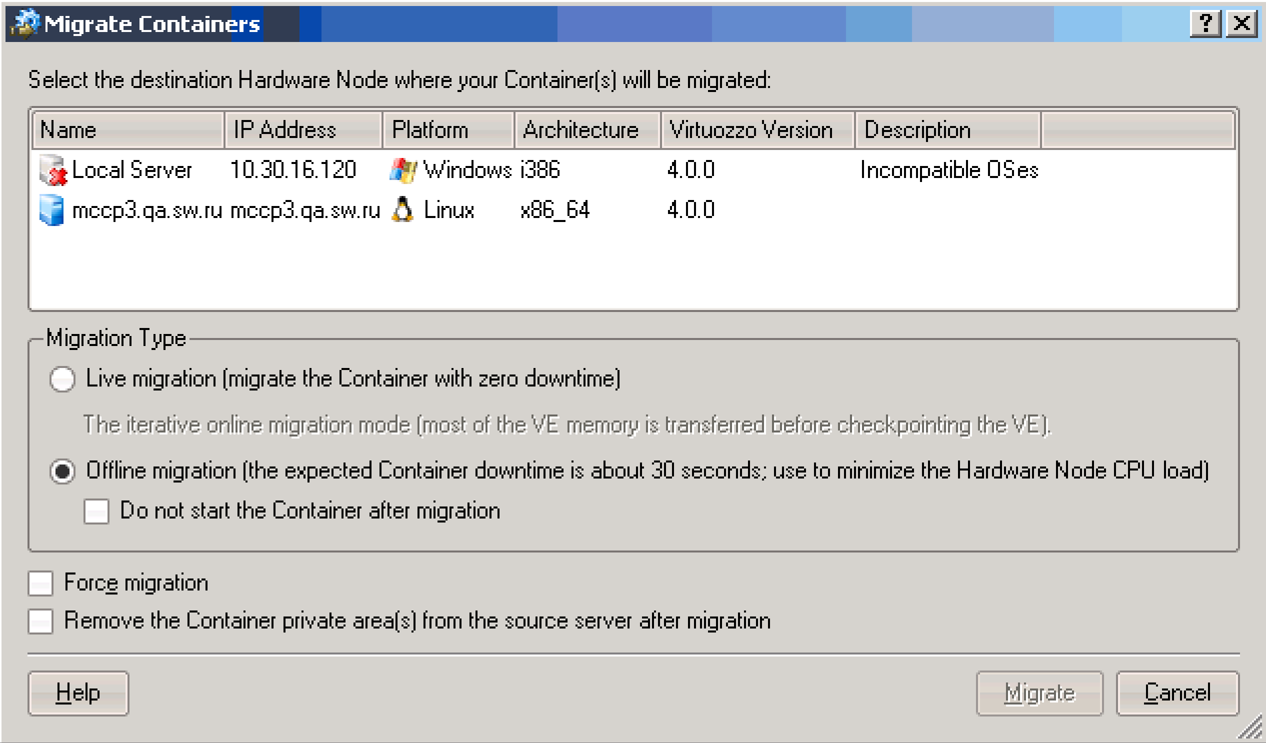

Figure 12: Management Console - Migrating Containers

In this window, you should do the following:

- select the Destination Node where you wish to move the Container;
- make sure that the **Offline migration...** radio button is selected, which allows you to migrate the Container using the standard migration technology.

You can also specify the following options for the Container to be migrated:

- The **Do not start the Container after migration** check box, if selected, prevents the migrated Container from starting on the Destination Node after its successful migration. This option does not have any effect if the Container was not running on the Source Node.

- The Force migration check box, if selected, forces the Container migration even if the templates necessary for the Container correct operation are not installed on the Destination Node. However, it will be impossible to start such a Container after the migration in case of the absence of the needed templates.
- Select the Remove the Container private area(s) ... check box to delete the Container private area from the Source Node after the Container successful migration.

When you are ready, click the Migrate button.

Zero-Downtime Migration

Starting with Virtuozzo Containers 3.0, the `vzmigrate` utility allows you to migrate your Containers from one Hardware Node to another with zero downtime. The zero downtime migration technology has the following main advantages as compared with the standard one:

- The process of migrating a Container to another Node is transparent for you and the Container applications and network connections, i.e., on the Source and Destination Nodes, no modifications of system characteristics and operational procedures inside the Container are performed.
- The Container migration time is greatly reduced. In fact, the migration eliminates the service outage or interruption for Container end users.
- The Container is restored on the Destination Node in the same state as it was at the beginning of the migration.
- You can move the Containers running a number of applications which you do not want to be rebooted during the migration for some reason or another.

Note: Zero-downtime migration cannot be performed on Containers having one or several opened sessions established with the `vzctl enter` *`CT_ID`* command.

Before performing zero-downtime migration, it is recommended to synchronize the system time on the Source and Destination Nodes, e.g. by means of NTP (http://www.ntp.org). The reason for this recommendation is that some processes running in the Container might rely on the system time being monotonic and thus might behave unpredictably if they see an abrupt step forward or backward in the time once they find themselves on the new Node with different system clock parameters.

In the current version of Virtuozzo Containers, you can make use of the following types of zero-downtime migration:

- *Simple online migration*. In this case a Container is 'dumped' at the beginning of the migration, i.e. all Container private data including the state of all running processes are saved to an image file. This image file is then transferred to the Destination Node where it is 'undumped'.
- *Lazy online migration*. Using this type of online migration allows you to decrease the size of the 'dumped' image file storing all Container private data and transferred to the Destination Node by leaving the main amount of memory in a locked state on the Source Node and swapping this memory from the Source Node on demand. Thus, the migrated Container can be started before the whole memory is transferred to the Destination Node, which drastically reduces the service delay of the corresponding Container. When a process tries to access a page of memory that has not yet been migrated, the request is intercepted and redirected to the Source Node where this page is stored.
- *Iterative online migration*. In this case the main amount of Container memory is transferred to the Destination Node before a Container is 'dumped' and saved to an image file. Using this type of online migration allows you to attain the smallest service delay.
- *Iterative + lazy online migration*. This type of online migration combines the techniques used in both the *lazy* and *iterative* migration types, i.e. some part of Container memory is transferred to the Destination Node before 'dumping' a Container and the rest is transported after the Container has been successfully 'undumped' on the Node.

To migrate a Container by using the zero downtime migration technology, you should pass the `--online` option to the `vzmigrate` utility. By default, the *iterative online migration* type is used to move a Container from one Hardware Node to another. For example, you can migrate Container 101 from the current Hardware Node to the Destination Node named `my_node.com` by executing the following command:

Note: If the CPU capabilities on the Source Node exceed those on the Destination Node (e.g. you migrate from a Source Node running the Pentium 4 processor to a Destination Node running the Pentium 3 processor), the migration may fail and you will be presented with the corresponding warning message. However, if you are sure that the CPU power on the Destination Node is sufficient to start and run the Container(s) being migrated, you can use the `-f` option to force the migration process.

```
# vzmigrate --online --require-realtime my_node.com 101
Enter password:
Connection to destination Hardware Node (192.168.1.57) \
is successfully established
Moving/copying Container#101 -> Container#101, [], [] ...
Syncing private area '/vz/private/101'
 - 100% |***************************************
done
Suspending Container#101 ...
done
Dumping Container#101 ...
done
...
Migration completed
```

The `--require--realtime` option tells `vzmigrate` to move the Container by using the *iterative online migration* type only. So, if this migration type cannot be carried out for some reason or other, the command will fail and exit. If this option is omitted and in the case of failure while performing the iterative migration, `vzmigrate` will try to move your Container by means of the *simple online migration* type or the *lazy online migration* type (if the `--lazy` option is given). You can specify more than one Container ID simultaneously; in this case, all specified Containers will be moved to a new Hardware Node one by one.

If you wish to use another migration type for moving your Containers to another Node, you should additionally pass certain options to `vzmigrate`:

- Specify the `--noiter` option to migrate a Container by using the *simple online migration* type;
- Specify the `--noiter` and `--lazy` options to migrate a Container by using the *lazy online migration* type;
- Specify the `--lazy` option to migrate a Container by using the *iterative + lazy online migrate* type.

To migrate one or more Containers in Parallels Management Console, select these Containers from the list in the right pane after selecting the **Containers** item in the left pane. Then right-click the selection and point to **Tasks** --> **Migrate to Another Hardware Node** on the context menu. Note that the target Hardware Node must be already registered in Parallels Management Console; otherwise, the migration option will not be available. A migration dialog appears, for example:

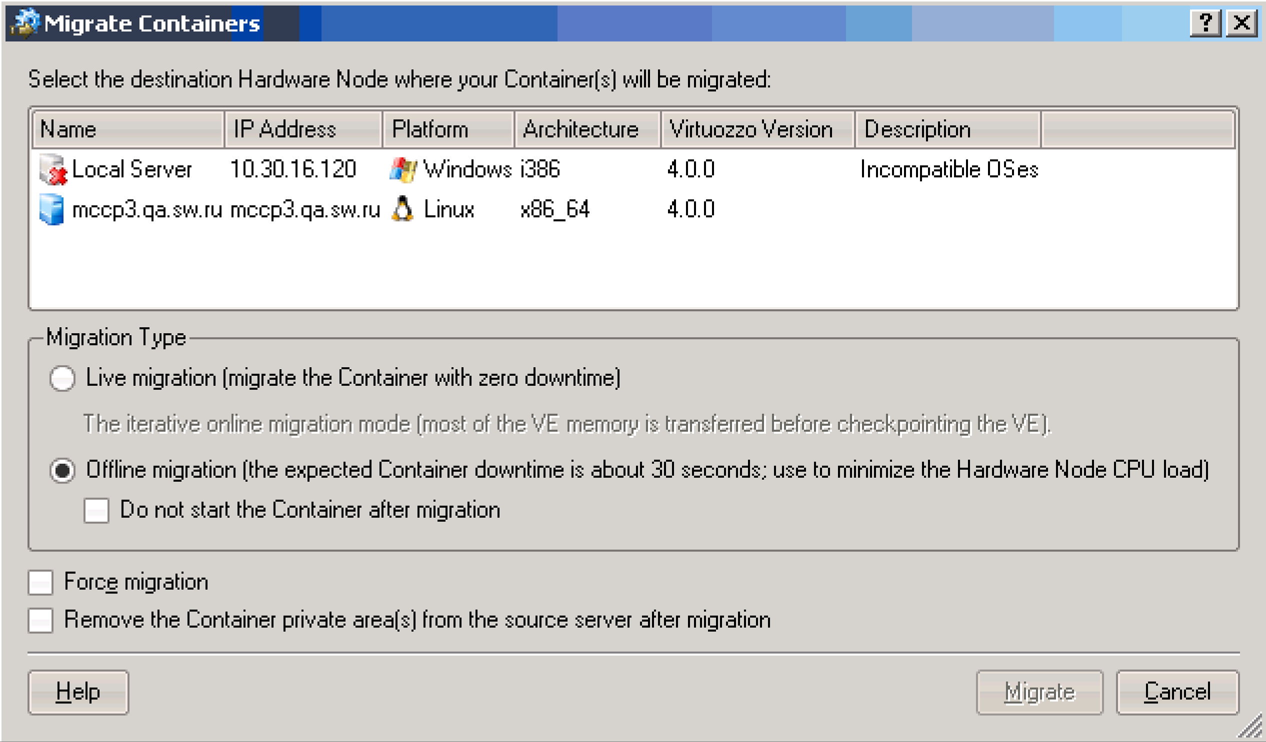

Figure 13: Management Console - Migrating Containers

In this window you can do the following:

- Select the target Hardware Node where you want to migrate the selected Container(s).
- Select the Live migration... radio button allowing you to migrate the Container using the zero downtime migration technology. In this case the Container will be migrated using the 'iterative online migration' type.
- Select the Force migration check box to force the Container migration even if the templates necessary for the Container correct operation are not installed on the Destination Node. However, it will be impossible to start such a Container after the migration in case of the absence of the needed templates.
- Select the Remove the Container private area(s) ... check box to delete the Container private area from the Source Node after the Container successful migration.

When you are ready, click the Migrate button.

Enabling Container Migration from 3.x to 4.0 Hardware Nodes

To enable the migration of Containers from Hardware Nodes running Virtuozzo Containers 3.0 or 3.0 SP1 to Virtuozzo Containers 4.0 Hardware Nodes, you should do the following:

1 Assign a public IP address to the Service Container and set the password of the `vzagent0` user inside this Container using the `vzctl set` command:

```
# vzctl set 1 --ipdel all --ipadd public_IP_address
               --userpasswd vzagent0:user_password
```

2 Restart the Parallels Agent software on the Hardware Node:

```
# vzagent_ctl restart
```

Moving Container Within Hardware Node

The vzmlocal utility allows you to move Containers within your Hardware Node. Moving a Container within one and the same Hardware Node consists in changing the Container ID and its private area and root paths. So, you may use vzmlocal to change the ID of the corresponding Container only or to additionally modify its private area and root path.

Let us assume that you wish to change the ID of your Container from 101 to 111 and modify its private area and root paths from /vz/private/101 to /vz/private/my_dir and from /vz/root/101 to /vz/root/ct111, respectively. To this effect, you should execute the following command on the Hardware Node:

```
# vzmlocal 101:111:/vz/private/my_dir:/vz/root/ct111
Moving/copying Container#101 -> Container#111,
[/vz/private/my_dir], [/vz/root/ct111] ...
...
Successfully completed
```

To check if Container 101 has been successfully moved to Container 111, you can use the following commands:

```
# vzlist -a
CTID      NPROC STATUS  IP_ADDR         HOSTNAME
   1         43 running 10.0.10.1       localhost
 111          - stopped 10.0.10.101     myContainer
# ls /vz/private
1  my_dir
# ls /vz/root
1  ct111
```

As can be seen from the example above, the ID of Container 101 has been changed to 111, its private area is now located in the /vz/private/my_dir directory on the Node, and the path to its root directory is /vz/root/ct111.

Notes: 1. You may perform a number of moving operations by a single invocation of the vzmlocal utility.

2. You may run the vzmlocal utility on both running and stopped Containers.

In Parallels Management Console, you can move Containers within your Hardware Node with the help of the Move Container wizard. To invoke the wizard, select the Virtuozzo Containers item under the corresponding Hardware Node name, right-click the Container you wish to change the ID of, and select Tasks -> Move Container on the context menu. You will be asked by the wizard to complete a number of tasks:

1 On the first step, you are to choose between two options:
   - The first option (Change Container ID) lets you specify a new ID for the corresponding Container in addition to specifying its new root and private area paths. Note that if you choose this option, you will not be able to preserve the old ID for this Container.
   - The second option (Change Container location on Hardware Node) allows you to specify new root and private area paths without changing the Container ID.

2 If you choose the first option, you should specify a new ID for the corresponding Container on the second step of the wizard. Please note that the old ID for this Container will be lost and all Container private data will be transferred to the `/vz/private/<new_CT_ID>` directory, where `<new_CT_ID>` denotes the new ID assigned to the Container (e.g. `/vz/private/111` for Container 111).

3 Next, you will presented with the **Set New Container Root and Private Area Paths** window:

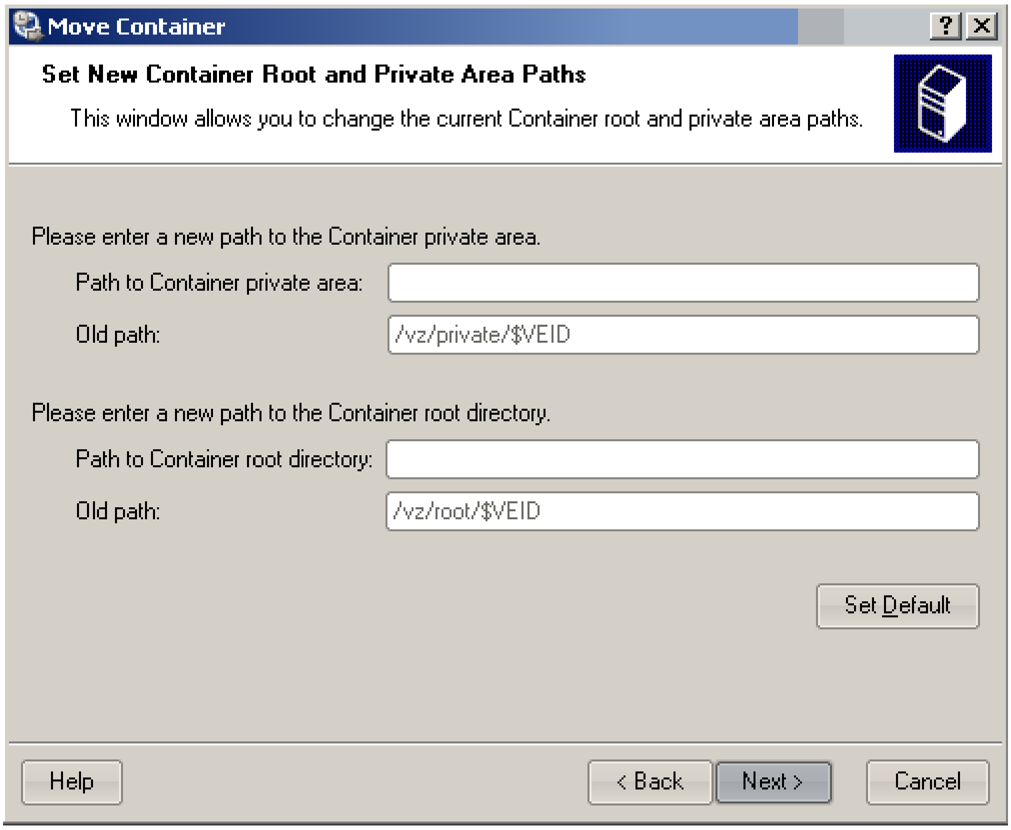

Figure 14: Management Console - Moving Container Within Hardware Node

This window is displayed in one of the following cases:

- You selected the **Change Container ID** check box on the first step of the wizard and then specified a new ID for your Container and clicked **Next** in the **Specify New Container ID** window. In this case the wizard will propose the default paths for you, but will leave you the possibility to alter these paths. To do it, check the corresponding check box and type the new private area or root path in the field thereunder. If have made some changes to the default paths and now wish to revert to these paths, click the **Set Default** button.
- You selected the **Change Container location on Hardware Node** check box and clicked **Next** on the first step of the wizard. In this case you can:

  -manually enter the new private and root paths for the Container or

  -click the **Set Default** button to display and use the paths proposed by the wizard.

4 On the last step of the **Move Container** wizard, you can review the settings made by you on the previous steps. Click the **Finish** button to begin the moving process. This process may take some time, so be sure to wait for it to complete.

Copying Container Within Hardware Node

The Virtuozzo Containers software allows you to create a complete copy of a particular Container (in respect of all the Container data and resources parameters), or a Container *clone*. This saves your time because you do not have to think of setting up the Container configuration parameters and the like. Moreover, you can create a number of Container clones at a sitting.

In Virtuozzo-based systems, you can use the `vzmlocal` utility to copy a Container within the given Hardware Node. For example, you can issue the following command to create Container 111 and make it be a complete copy of Container 101:

Note: You can clone both running and stopped Containers.

```
# vzmlocal -C 101:111
Moving/copying Container#101 -> Container#111, [], [] ...
Syncing private area '/vz/private/101'->'/vz/private/111'
...
Successfully completed
# vzlist -a
CTID      NPROC STATUS  IP_ADDR         HOSTNAME
  1         42 running 10.0.10.1       localhost
101         10 running 10.0.10.101         Container115
111          - stopped 10.0.10.115         Container115
```

As you can see from the example above, a clone of Container 101 (i.e. Container 111) has been successfully created. However, before starting to use Container 111, you should set another IP address and another hostname for this Container which are currently identical to those of Container 101. Please consult the **Configuring Container** section (p. 46) to learn how you can do it.

The `vzmlocal` utility also enables you to override the default private area and root paths of the destination Container which, by default, are set to `/vz/private/<dest_CTID>` and `/vz/root/<dest_CTID>`, respectively (where `<dest_CTID>` denotes the ID of the resulting Container). In the case of Container 111, these paths are `/vz/private/111` and `/vz/root/111`. To define custom private area and root paths for Container 111, you can execute the following command:

```
# vzmlocal -C 101:111:/vz/private/dir_111/:/vz/root/ct111
Moving/copying Container#101 -> Container#111, [], [] ...
Syncing private area '/vz/private/101'->'/vz/private/dir_111'
...
Successfully completed
# ls /vz/private
1  101 dir_111
# ls /vz/root
1  101 ct111
```

To create a Container clone in Parallels Management Console, click **Virtuozzo Containers** under the name of the corresponding Hardware Node, and as soon as a list of Containers appears, right-click the Container you are going to clone. Select **Tasks** on the context menu and proceed with the **Clone Container(s)** option. The **Clone Container** wizard will guide you through the process of cloning the Container:

1 First, you will need to specify the number of Container clones to create and the starting Container ID.

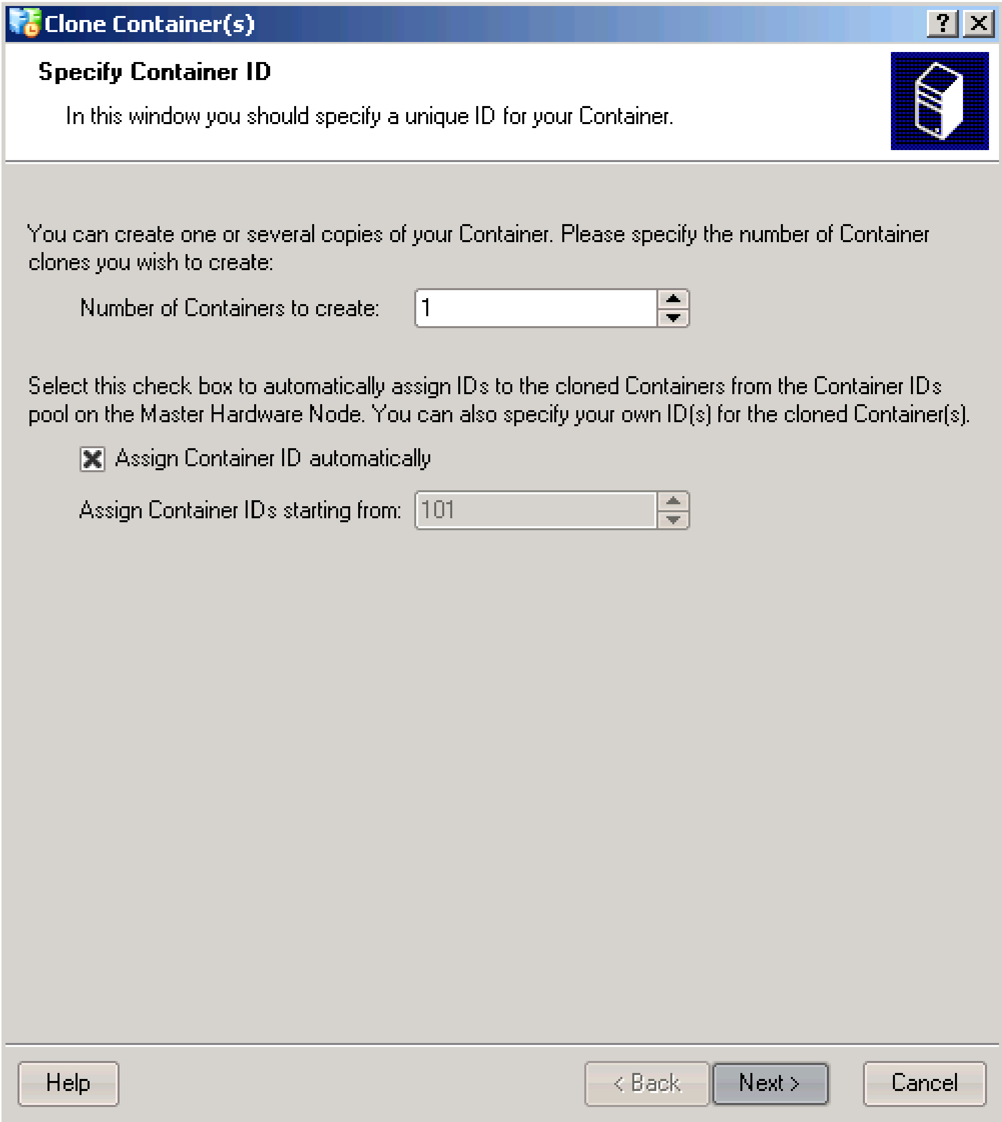

Figure 15: Management Console - Cloning Container

The number of clones depends on the capacity of the Hardware Node. This taken into account, it is safe to create up to 100 Container clones at one time. The default is 1.

Similarly to creating new Containers, the Clone Container wizard allows the simultaneous creation of several Container clones with IDs in a continuous series only. The default starting Container ID, which is automatically offered, is the first unoccupied ID starting from 101. For example, if you already have Containers with IDs from 101 through 105 and 107, the ID of 106 will be offered by default. And if you are creating only one Container clone, you may safely accept this number. Or you can specify any other number, and the system will check up if the ID is unoccupied. However, if you are going to create a number of Container clones, it is recommended to decide on an unoccupied ID series in advance.

2 On the second step, you will be asked to define a new name and a new hostname for the resulting Container. Type an arbitrary name you consider suitable for the Container in the Name field and indicate its hostname, if necessary, in the Hostname field.

3 In the Assign Network Settings to Containers window, you can view and configure the virtual network adapters that will be available inside the Container clone. Detailed information on all network parameters and on the way to manage them is provided in the Configuring Virtual Adapter Parameters subsection.

4 On the next step, you can change the path to the private area and root directory of the Container clone by selecting the corresponding Override... check boxes and entering the desired paths in the fields provided.

5 The last window lets you review the parameters provided by you on the previous steps. You can also select the Start the cloned Container after its creation check box to immediately start the Container after its successful cloning. Click Finish to start the copying process.

Parallels Management Console also allows you to create several copies of a Container at once. To this effect, you should right-click the Containers you are going to clone in the Management Console right pane, select Tasks --> Clone Container(s) on the context menu, and, in the displayed window, provide the necessary information for the cloned Containers.

Backing Up and Restoring Containers

A regular backing up of the existing Containers is essential for any Hardware Node reliability. Any Container is defined by its private area, configuration files, action scripts, and quota information. The Virtuozzo Containers software allows to back up all these components. Each backup file may be of one of the following 3 types:

- A full backup containing all Container data. This kind of backup is the most time-consuming, space-intensive, and the least flexible one. However, full backups are the quickest to restore.
- An incremental backup containing only the files changed since the last full, differential, or incremental backup. Incremental backups record only the changes since the last Container backup (either full, differential, or incremental) and, therefore, are less in size and take less time to complete than the full and differential backups.
- A differential backup containing only the files changed since the last full backup. This kind of backup does not take into account available incremental and differential backup archives and always backs up all the files modified since the last full backup.

Using vzabackup/vzarestore Utilities

A regular backing up of the existing Containers is essential for any Hardware Node reliability. Virtuozzo Containers 4.0 is shipped with the `vzabackup` and `vzarestore` utilities allowing you to back up and restore your Hardware Nodes and their Containers. These utilities can be run on virtually every Node in your network:

- on the Source Node where the Container to be backed up is residing;
- on the Backup Node - a special Node intended for storing Container backups (if you have any), or
- on any other Parallels Virtuozzo-based physical server in your network.

The only requirements all the Nodes should meet to successfully run `vzabackup` and `vzarestore` on them is to have a server with the `vzabackup` package installed and to provide the network connectivity for this server to be able to establish connections to the Source and Backup Nodes, if necessary. The `vzabackup` package needs the Parallels Agent software to be installed on the Node for its functioning; so, you may need to install this software first. The created Hardware Node and Container backups are stored on the Backup Node which can also be presented by any server in your network with the running Parallels Agent software.

Note: The `vzabackup` and `vzarestore` utilities can be used to back up and restore Hardware Nodes running Virtuozzo Containers 4.0 and their Containers. For information on how to create backups of Hardware Nodes with earlier versions of Parallels Virtuozzo Containers installed and their Containers, please turn to the Running vzabackup/vzarestore Utilities section (p. 274).

`vzabackup` can be used to back up both the Hardware Node itself and all its Containers. Let us assume the following:

- You wish to create a full backup of Container 101 residing on the Source Node with the IP address of `192.168.0.15`.
- The credentials to access the Source Node are `source_root` and `1234qwer`.
- The backup will be created with the high level of compression.
- The Backup Node where the resulting backup archive will be stored has the IP address of `192.168.200.200` and the credentials of `backup_root` and `1qaz2wsx`.
- You wish to exclude the `/tmp` directory inside Container 101 from the backup process.
- You wish to provide the following description for the resulting backup archive: `The MySQL database - latest changes`.

To create a backup with the aforementioned parameters, you can execute the following command on any Hardware Node with `vzabackup` installed and having the network connectivity to the Source and Backup Nodes:

```
# vzabackup -D "The MySQL database - latest changes." -C3 \
             --storage backup_root:1qaz2wsx@192.168.200.200 \
             source_root:1234qwer@192.168.0.15 -e 101 \
             --exclude-files /tmp
...
* Sending private backup data
* Backup storage: storing private backup data
* Backup storage: filling resultant backup info
* Removing obsolete backups
* Checking parameters
```

```
* Dumping quota
* Backup storage: preparing to backup
* Adjusting backup type (full)
* Backup storage: receiving backup file
* Backing up private area
 100% ***************************************************
...
```

Upon the command completion, the created backup archive will be put to the backup directory on the Source Node; by default, this directory is `/vz/backups`. Later on, the Container backups may be restored from this directory.

You may specify any number of Hardware Nodes IP addresses in the command line. You can also perform an incremental or a differential backup by additionally specifying the `-I` or `--Tdiff` option, respectively. If you indicate the `–I` or `--Tdiff` option, and the utility cannot find the corresponding full backup, a full backup is performed. You can omit the indication of the Backup Node if you wish to use your local Node to store the backup archive. Detailed information on all options which can be passed to the `vzabackup` utility is provided in the Parallels Virtuozzo Containers Reference Guide.

Before starting to restore any Hardware Nodes or separate Containers previously backed up, you might want to view first the information about these Nodes or Containers. This can be done by running the `vzarestore` utility on the Source Node (or on any other Node where `vzabackup` is installed), e.g.:

```
# vzarestore --list --storage backup_root:1qaz2wsx@192.168.200.200
...
Show existing backups...
Title       Creation date/time      Type  Size
Container101       2007-02-11T111507+0004  full  8.79 Mb
localhost          2007-02-11T112810+0004  full  150.01 Mb
MyContainer        2007-02-11T113831+0004  full  8.81 Mb
comp1              2007-02-11T110447+0004  full  8.68 Mb
...
```

If you are running `vzarestore` on the Backup Node itself, you may omit the `--storage` option.

To do the proper restoring of Container 101, issue the following command on the Source Node (or on any other Node where `vzabackup` is installed):

```
# vzarestore 101 --storage backup_root:1qaz2wsx@192.168.200.200
...
Restore environment: Container101 from 1361ac21-4cae-4981-...
...
```

This command will restore the latest backup of Container 101 stored on the Backup Node with the IP address of `192.168.200.200` to the Node where you have run the command. If you wish to restore a certain (not the latest) Container backup, you should use the `-b` option and specify the ID of the created backup instead of the Container ID. You can find out what backup ID is assigned to this or that Container backup using the `-l` and `-f` options of the `vzarestore` command. You can also restore only certain files from the backup archive of Container 101 using the `--files` option. For detailed information on all options which can be used with the `vzarestore` utility, please turn to the Parallels Virtuozzo Containers Reference Guide.

Managing Backups in Parallels Management Console

Parallels Management Console deals with three kinds of Nodes - the *Source Nodes* (the Nodes where Containers are hosted during their backing up); the *Backup Nodes* (the Nodes where Container backups are stored); and the *Destination Nodes* (the Nodes where Container backups are restored).

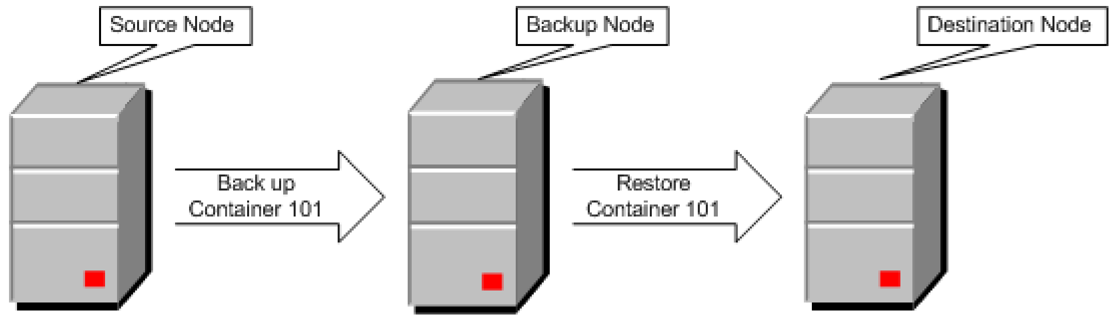

Figure 16: Backup Overview

These Nodes are singled out by their functionality only. In reality, one and the same Hardware Node may perform two or even three functions. Usually, the Source and Destination Node are represented by one and the same Hardware Node, because you will likely want the Containers you back up to be restored to their original Node. However, setting up a dedicated Backup Node is recommended.

You should make sure that all the three Nodes are registered in Management Console before starting to work with them.

Parallels Management Console lets you perform the following backup-related operations:

- Assign the default Backup Node for the given Source Node;
- Set the default backup location on the Backup Node;
- Back up a single Container from the Source Node to the Backup Node;
- Back up a number of Containers or the whole Hardware Node (i.e. all the Containers on the given Node) to the Backup Node;
- Restore a single Container from the Backup Node to the Destination Node;
- Restore a number of Containers or the whole Hardware Node from the Backup Node;
- Restore individual files from the Container backup on the Backup Node to the Destination Node;
- Directly manage the Backup Nodes;
- Search the backup of a given Container from the Source Node across all the Backup Nodes;
- Automate the task of backing up your Containers by setting Container backups to be run on a schedule.

Setting Default Backup Parameters

The Virtuozzo Containers software allows you to specify a number of default backup parameters which can then be used when creating Container backup archives. These parameters include:

- the default Backup Node where Container backups are to be stored;
- the default backup location, i.e. the exact place on the Backup Node where Container backups are to be stored;
- the default backup compression level (p. 75);
- the default backup type (p. 77).

All the aforementioned operations are described in the following subsections in detail.

Assigning Default Backup Node

When you are backing up Containers from a Source Node, you shall always specify on what Node the resulting backups should be placed, i.e. the Backup Node. Parallels Management Console allows you to set the default Backup Node for the given Source Node, i.e. for the Node for which the window has been invoked, by performing the following operations:

1 Right-click the respective Source Node and choose Backup --> Set Default Backup Options on the context menu.

2 In the displayed window, click the Change button opposite the Server field:

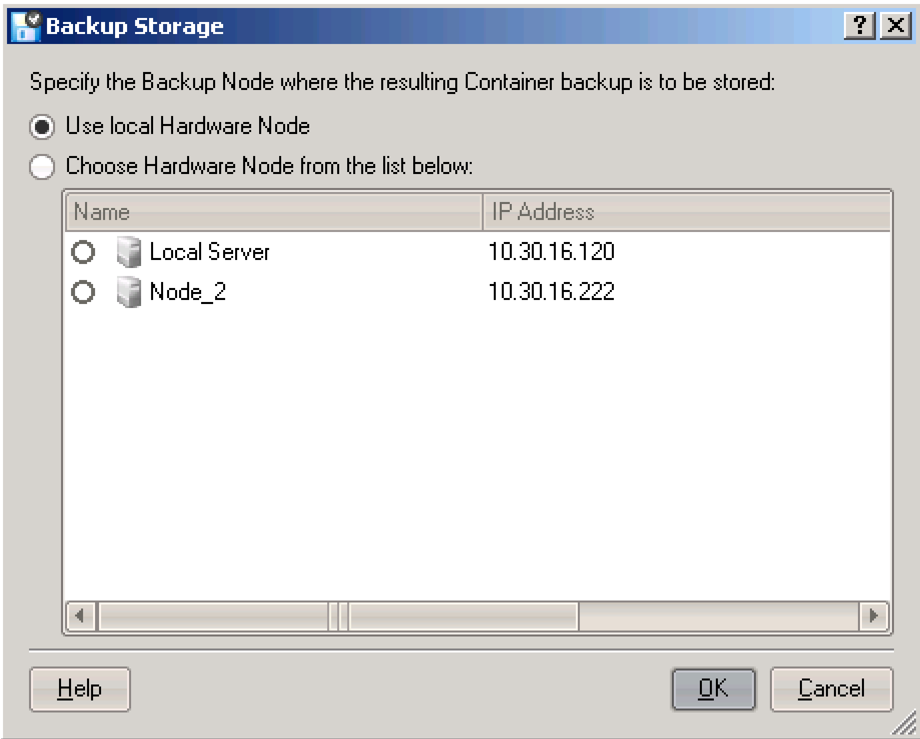

Figure 17: Management Console - Setting Default Backup Storage

3 In this window you can do the following:

- If you do not wish to use a dedicated Node for storing Container backups, select the Use local Hardware Node radio button and click OK to set the Source Node as the default Backup Node.

- If you are going to use a dedicated Node for storing Container backups, select the **Choose Hardware Node from the list below** radio button. The table below this radio button presents a list of Nodes registered in Management Console together with their IP addresses. If the default Backup Node already exists for the given Source Node, it is selected in the table. You should select the Node you wish to be the default Backup Node for the given Source Node and click **OK**.

4 Click **OK**.

The assignment of the default Backup Node brings about the following effects:

- When backing up Containers from the corresponding Source Node in Parallels Management Console and Infrastructure Manager using the 'default' backup mode, the backups will be automatically placed onto the default Backup Node.
- When backing up Containers form the corresponding Source Node in Parallels Management Console and Infrastructure Manager using the 'custom' backup mode, you will be automatically suggested to place the backups onto the default Backup Node.
- When a Container administrator backs up their Container by means of Parallels Power Panel, the corresponding backup is automatically placed on the default Backup Node.

There are no restrictions as to what Hardware Node may be the default Backup Node. The only requirements that this Node should meet are to be registered in Management Console (otherwise, it will not be displayed in the table on the **Backup Storage** screen) and to have sufficient disk space for housing multiple backups.

Notes: 1. You can use any Hardware Node as a Backup Node irrespective of a Virtuozzo Containers version installed on this Node. So, you can back up a Container from the Node running the Virtuozzo Containers 32-bit version and store it on the Node running the Virtuozzo Containers 64-bit version and vice versa.

2. If you use Parallels Management Console 3.0 to set the default Backup Node for a Hardware Node running Virtuozzo Containers 4.0, this setting will not be taken into account by Parallels Management Console 4.0.

Setting Default Backup Location

Parallels Management Console allows you to change the location of the directory on the Backup Node where all Container backups are to be stored. By default, the `/vz/backup` directory is used. To set another backup directory to be used as the default one for storing Container backups, you should right-click the corresponding Hardware Node in the left pane of the Management Console main window and select Backup --> Set Default Backup Location on the context menu. The following window is displayed:

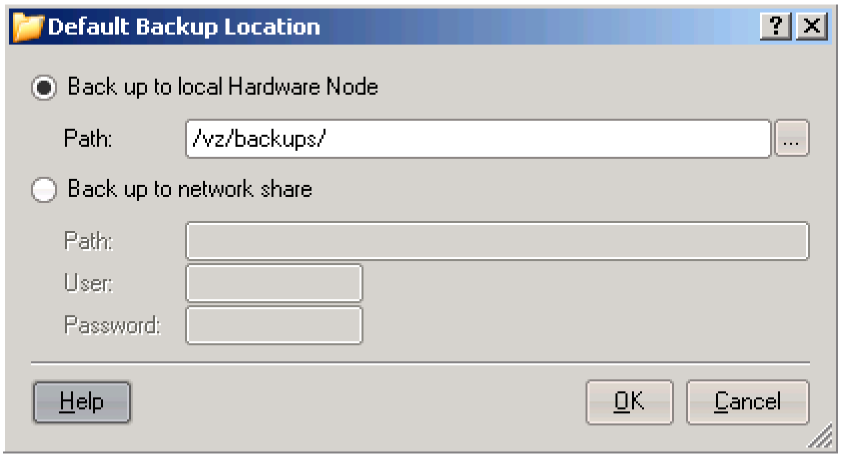

Figure 18: Management Console - Setting Default Backup Location

In this window you can do one of the following:

- Select the Back up to local Hardware Node radio button to specify a backup directory on one of the Backup Node local disk drives. To set a new backup directory, you should type its full path on the Node in the Path field or click the ... button and select the desired directory in the displayed window.
- Select the Back up to network share radio button to specify a backup directory on a network share, i.e. on a Backup Node network drive. To this effect, you should enter the full path to the directory on the network drive in the Path field. If the network drive where your backup directory is to be located is password-protected, you should additionally specify the user name and password to access this share in the User and Password fields, respectively.

After you have specified the path to a new directory for storing Container backups, click OK for the changes to take effect.

Note: While defining the default backup directory, make sure that the disk drive where this directory is to be located has sufficient disk space for housing multiple Container backups.

Defining Default Backup Compression Level

Parallels Virtuozzo Containers 4.0 allows you to configure the default backup compression level by setting it to one of the following:

- None: in this case the Container backup is created without any compression. Using this level of compression, you may greatly reduce the backup creation time; however, the size of the resulting backup file may significantly increase as compared to other compression levels.
- Normal: in this case the Container backup is created with a normal level of compression. This compression level is set by default and suitable for backing up most Container files and folders.
- High: in this case the Container backup is created with the high level of compression. The size of the resulting backup file is smaller than that of the backup file compressed in the 'normal' and 'none' modes; however, it takes longer to create the backup file.
- Maximum: in this case the Container backup is created with the maximal level of compression. The size of the resulting backup file is the smallest and the time of the backup creation - the longest.

In general the optimal data compression level depends on the type of files to be stored in the backup archive. For example, it is advisable to use the 'normal' and 'none' compression types if most of the files to be backed up are already compressed (e.g. the files with the `.zip` and `.rar` extensions) or can be compressed with a low degree of efficiency (e.g. all executable files with the `.exe` extension or image files with the `.jpg`, `.jpeg`., and `.gif` extensions).

To configure the default backup compression level, you should perform the following operations in Parallels Management Console:

1 Right-click the respective Source Node and choose Backup --> Set Default Backup Options on the context menu:

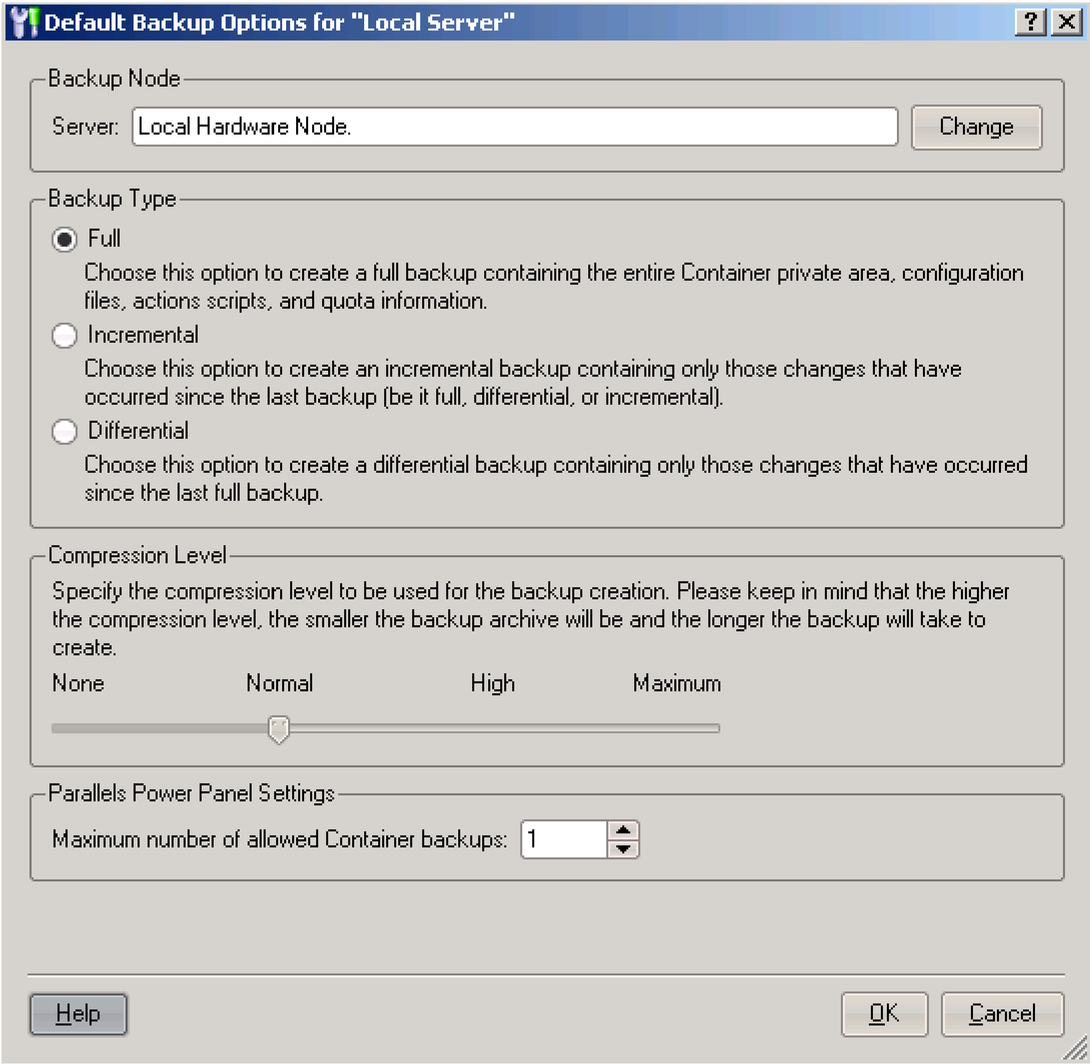

Figure 19: Management Console - Setting Default Backup Compression Level

2 Under the **Compression Level** group in the displayed window, move the slider to the left or to the right to specify the desired compression level.

3 Click **OK**.

Specifying Default Backup Type

Another parameter that you may wish to configure and that will be applied to all Container backups created using the default backup mode is the backup type. Each backup file may be of one of the following 3 types:

- A full backup containing the whole Container private area and its configuration file.
- An incremental backup containing only the files changed since the full backup or the previous incremental backup. An incremental backup may prove very useful because it records only the changes since the last Container backup (either full or incremental) and therefore is much less in size and takes much less time than the full backup. However, after several consecutive incremental backups it is recommended to create a full backup de nouveau and start the incremental backups chain from scratch.
- A differential backup containing only the files changed since the last full backup. As a rule, this kind of backup requires less space than a full backup, but more space than an incremental backup.

You can configure the default backup type by perform the following operations in Parallels Management Console:

1 Right-click the respective Source Node and choose **Backup --> Default Backup Node Configuration** on the context menu:

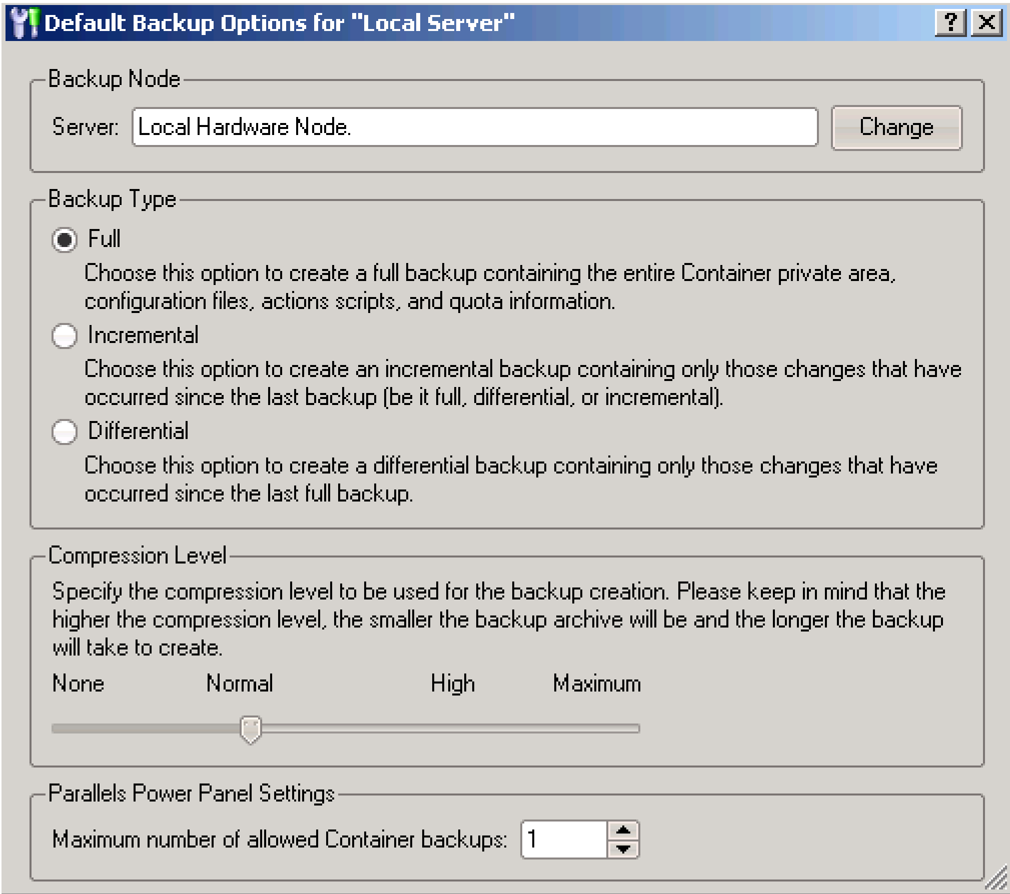

Figure 20: Management Console - Setting Default Backup Type

2 Under the **Backup Type** group in the displayed window, choose one of the following options:

- Select the **Full** radio button to always create full backup archives containing the whole Container private area, all Container-related configuration files, action scripts, etc.
- Select the **Incremental** or **Differential** radio button to always perform incremental or differential backups, respectively. If an incremental or differential backup is performed, and the corresponding full backup cannot be found, a full backup is automatically performed.

3 Click **OK**.

Backing Up Single Container

To back up a single Container on the Source Node, do the following:

1 In Parallels Management Console, click the **Virtuozzo Containers** item under the corresponding Source Node to open the Container manager window.

2 Right-click the Container you wish to back up and select **Backup** --> **Back Up Container** on the context menu. The **Back Up Containers** wizard opens:

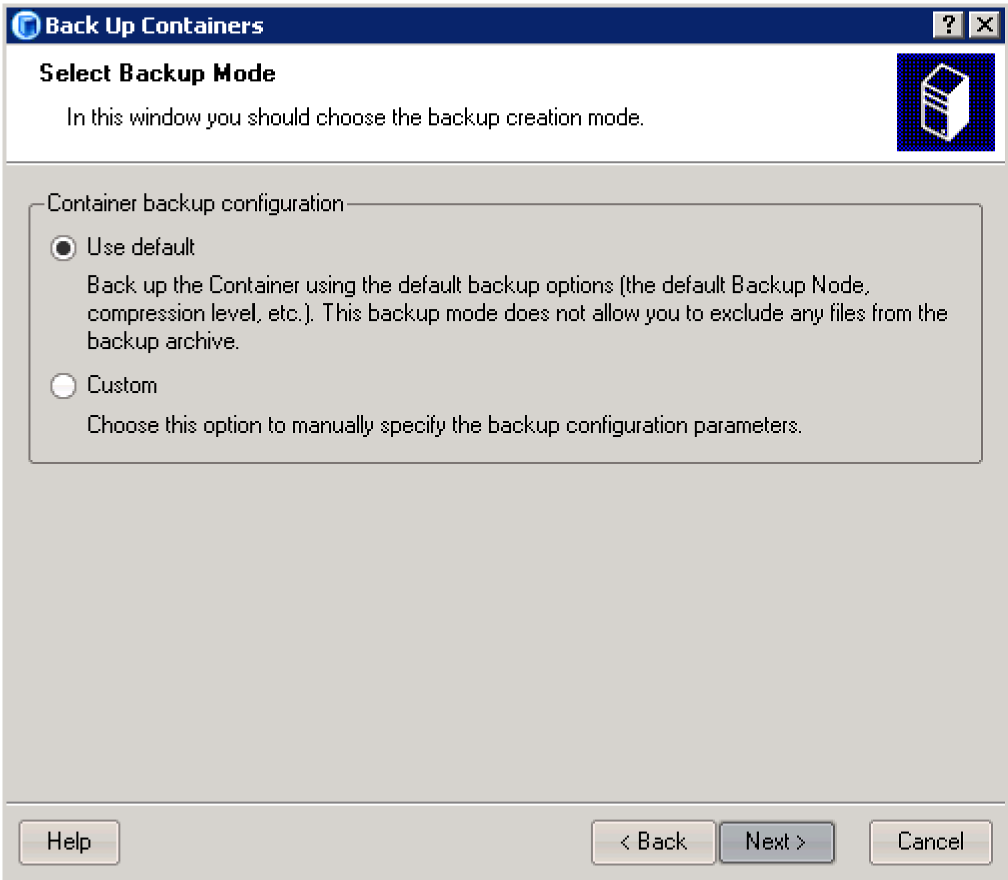

Figure 21: Management Console - Choosing Backup Mode

3 On the first step of the wizard, you should choose the Container backup mode:

- **Default**: select this radio button to back up the Container using the default backup mode. When run in this mode, the default backup parameters are used for creating the Container backup. You can only set the backup description and configure the default backup policy.

Note: Detailed information on what default backup parameters are and how to manage them is given in the Setting Default Backup Parameters subsection (p. 72).

- Custom: select this radio button to manually set the parameters to be applied to the resulting backup archive. In this case you will have to go through a number of steps (Steps 4 and 5) of the Back Up Containers wizard and set all the parameters of the Container backup one by one.

4 On the second step of the wizard, you should specify the files and directories to be included in the backup:

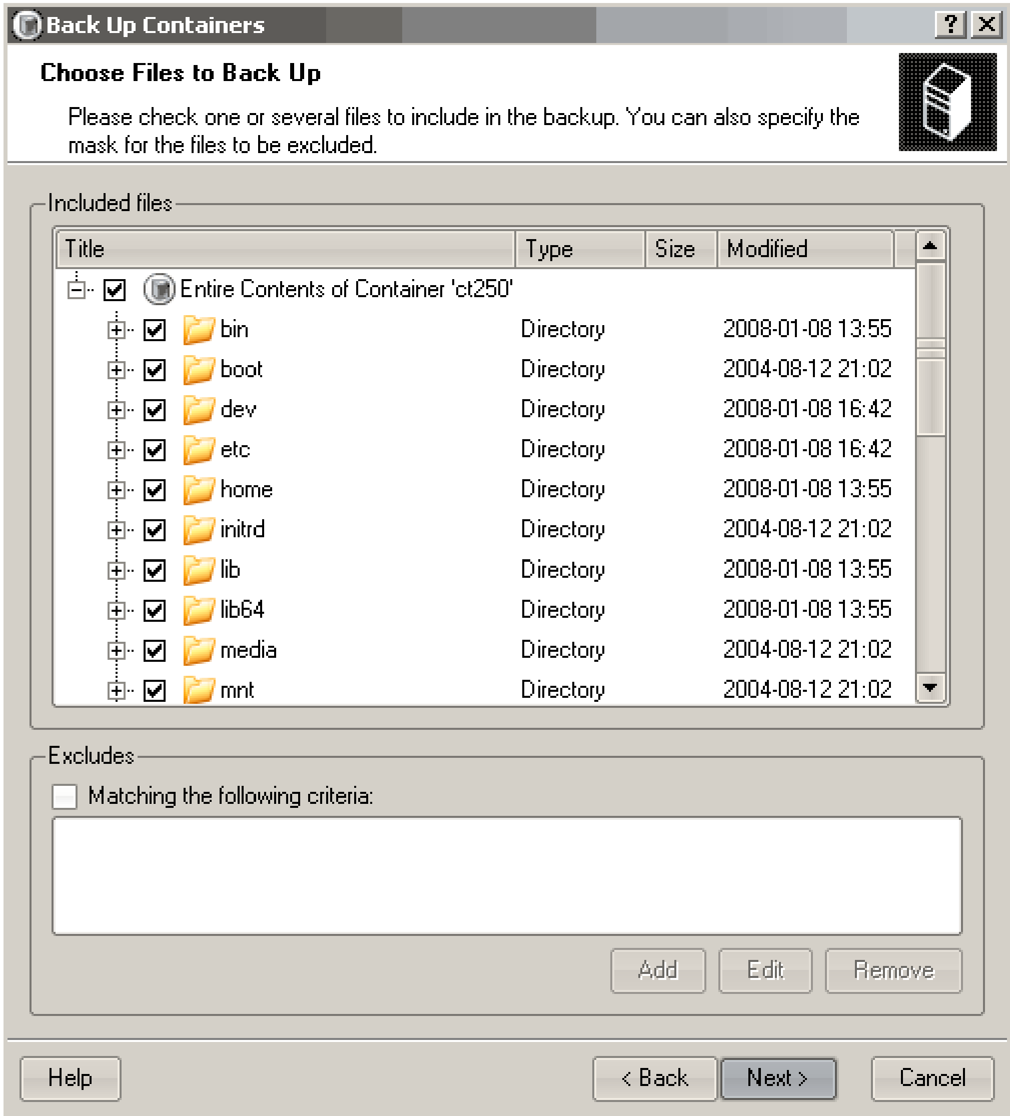

Figure 22: Management Console - Choosing Files and Directories to Back Up

By default, all the Container files and directories will be included in the backup archive. To leave out a file or directory from the backup process, clear its check box in the **Included files** table. You can also select the **Matching the following criteria** check box and use the **Add**/**Edit**/**Remove** buttons to set the parameters to be met by the file/directory to exclude it from the backup process. You can specify the full path to the corresponding file/directory, enter its name, or define any filter compatible with standard Linux masking rules (i.e. with standard globs). For example, you can indicate `/usr/MyDirectory/MyFile.txt` to exclude the `MyFile.txt` file from the backup process or type `*.bmp` to leave out all files with the `bmp` extension.

5 Next you should specify the main backup parameters:

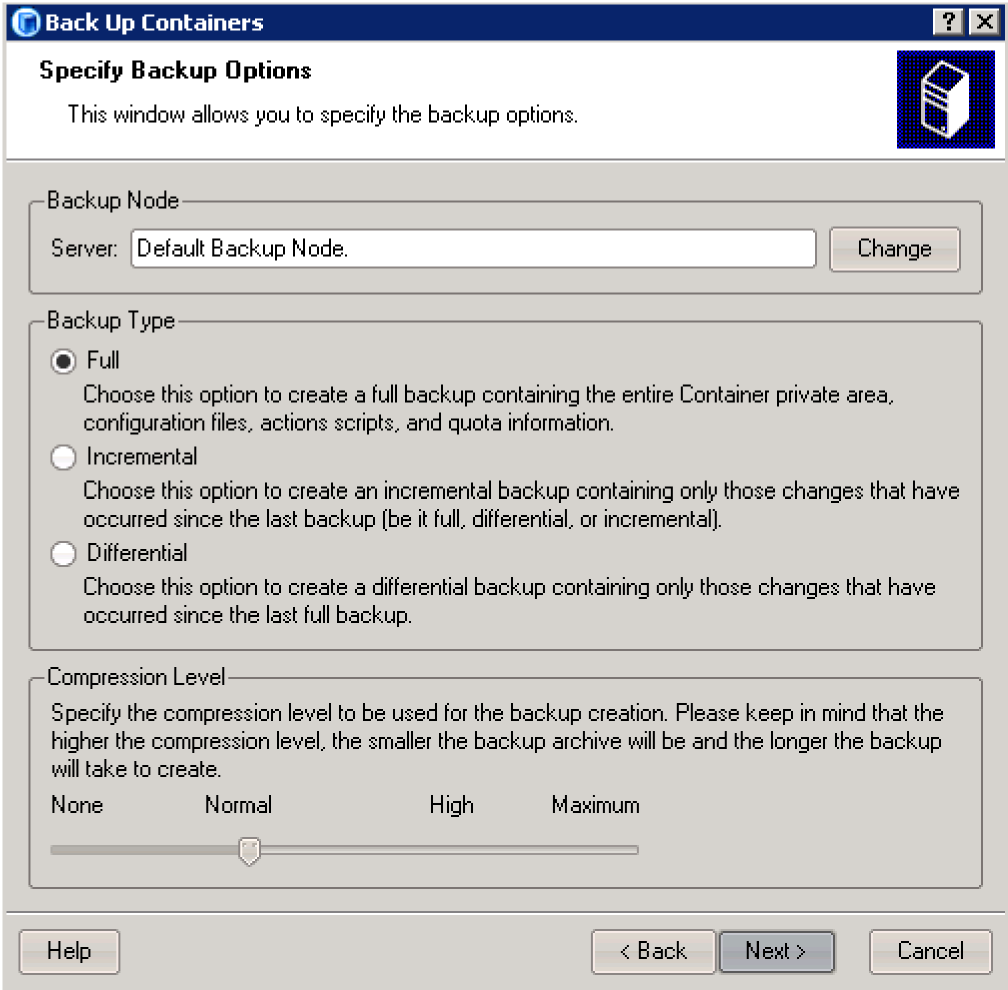

Figure 23: Management Console - Specifying Main Backup Parameters

In this window you can configure the following backup parameters:

- Choose the Backup Node where the Container backup is to be stored. You may leave the Backup Node offered by Parallels Management Console by default or use the Change button to specify the desired Backup Node. For detailed information on Backup Nodes, please consult the Assigning Default Backup Node subsection (p. 72).
- Decide on the backup compression level: 'None', 'Normal', 'High', or 'Maximum'. Detailed information on all compression levels is provided in the Defining Default Compression Level subsection (p. 75).
- Specify the backup type. It may be full or incremental. Detailed information on backup types is provided in the Specifying Default Backup Type subsection (p. 77). If you are backing up a single Container, and no backup of this Container has been found on the Backup Node, the Backup Type group is not shown, and a full backup is automatically created.

6 On the next step of the wizard, you can set the following parameters for the Container backup:

- Provide the backup description in the **Backup description** field, if necessary. The description can be any text containing any backup-related information (e.g. the backup purpose).
- Do not stop the Container backup even if any errors appear (the **Do not stop on errors** check box is selected) or break the backup process should any malfunction occur (the check box is cleared).
- Do not stop the backup process if one or more of the Containers to be backed up is not present on the Source Node (the **Ignore non-existent Containers** check box is selected) or break the backup process if any Container is absent (the check box is cleared). This option can be used when backing up several Containers at once.

7 The last screen allows you to review the information provided by you on the previous steps of the wizard. Click **Finish** to start creating the Container backup; otherwise, click **Back** to return to any step and correct the corresponding parameter.

Backing Up Group of Containers

To back up several or all Containers from a single Source Node, right-click the Virtuozzo Containers item under the corresponding Source Node and select Backup --> Back up Containers on the context menu. The Back Up Containers wizard is displayed. In this wizard you should:

1 Choose the Containers from the Source Node you wish to back up:

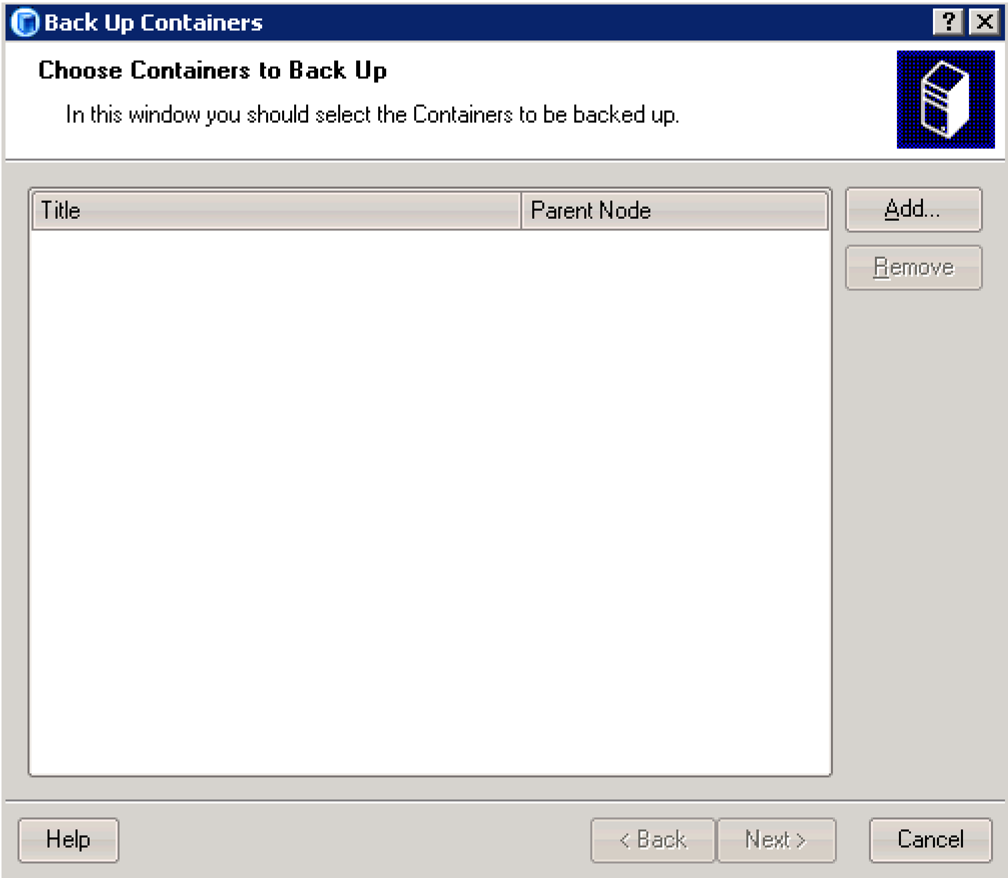

Figure 24: Management Console - Choosing Containers to Back Up

To schedule one or more Containers for backing up, click the Add button in the top left corner and, in the displayed window, select the names of the appropriate Containers and click OK. The selected Containers will be shown in the table on the Choose Containers to Back Up screen. Click Next to proceed with the wizard.

2 Choose the Container backup mode:

- Default: select this radio button to back up the Container using the default backup mode. When run in this mode, the default backup parameters are used for creating the Container backup. You can only set the backup description and configure the default backup policy.

Note: Detailed information on what default backup parameters are and how to manage them is given in the Setting Default Backup Parameters subsection (p. 72).

- Custom: select this radio button to manually set the parameters to be applied to the resulting backup archive. In this case you will have to go through a number of steps (Steps 3 and 4) to of the Back Up Containers wizard and set all the parameters of the Container backup one by one.

3 Specify the files and folders to be included in the backup:

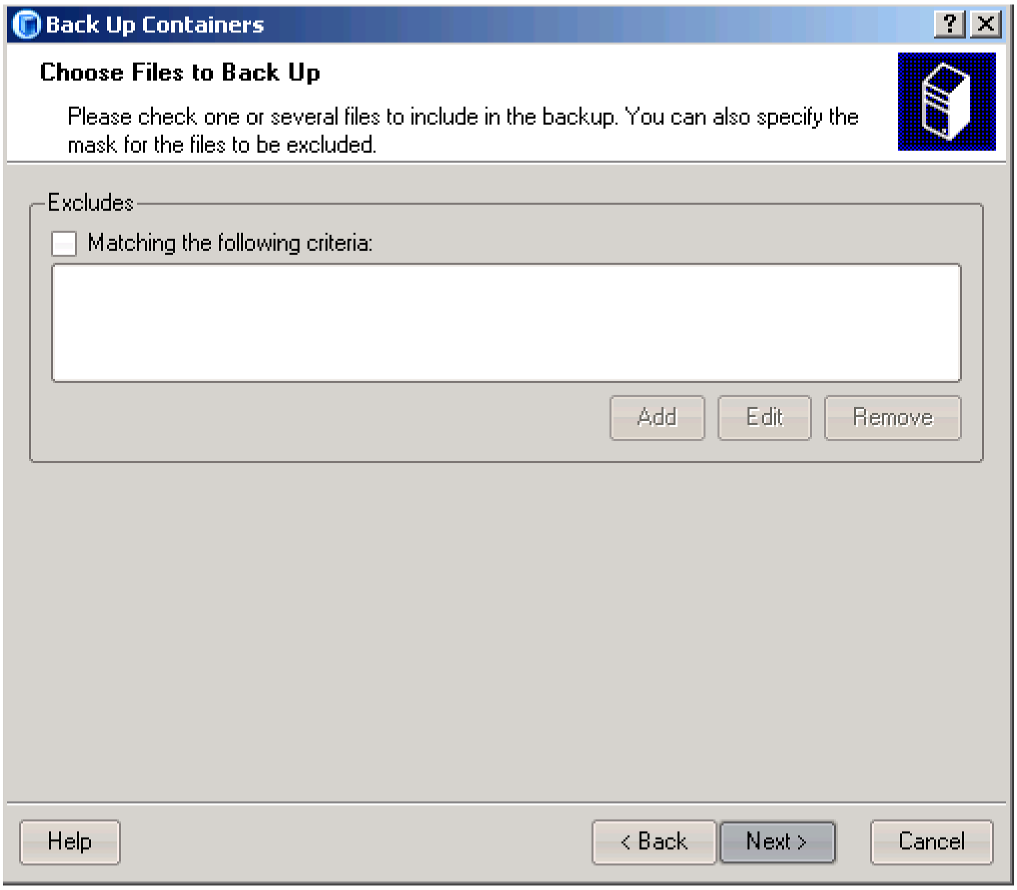

Figure 25: Management Console - Choosing Files to Back Up

By default, all the Container files and directories are included in the backup archive. However, you can select the Matching the following criteria check box and use the Add/Edit/Remove buttons to set the parameters to be met by the file/directory to exclude it from the backup process. You can specify the full path to the corresponding file/directory, enter its name, or define any filter compatible with standard Linux masking rules (i.e. with standard globs). For example, you can indicate `/usr/MyDirectory/MyFile.txt` to exclude the `MyFile.txt` file from the backup process or type `*.bmp` to leave out all files with the `bmp` extension.

4 Next you should specify the main backup parameters:

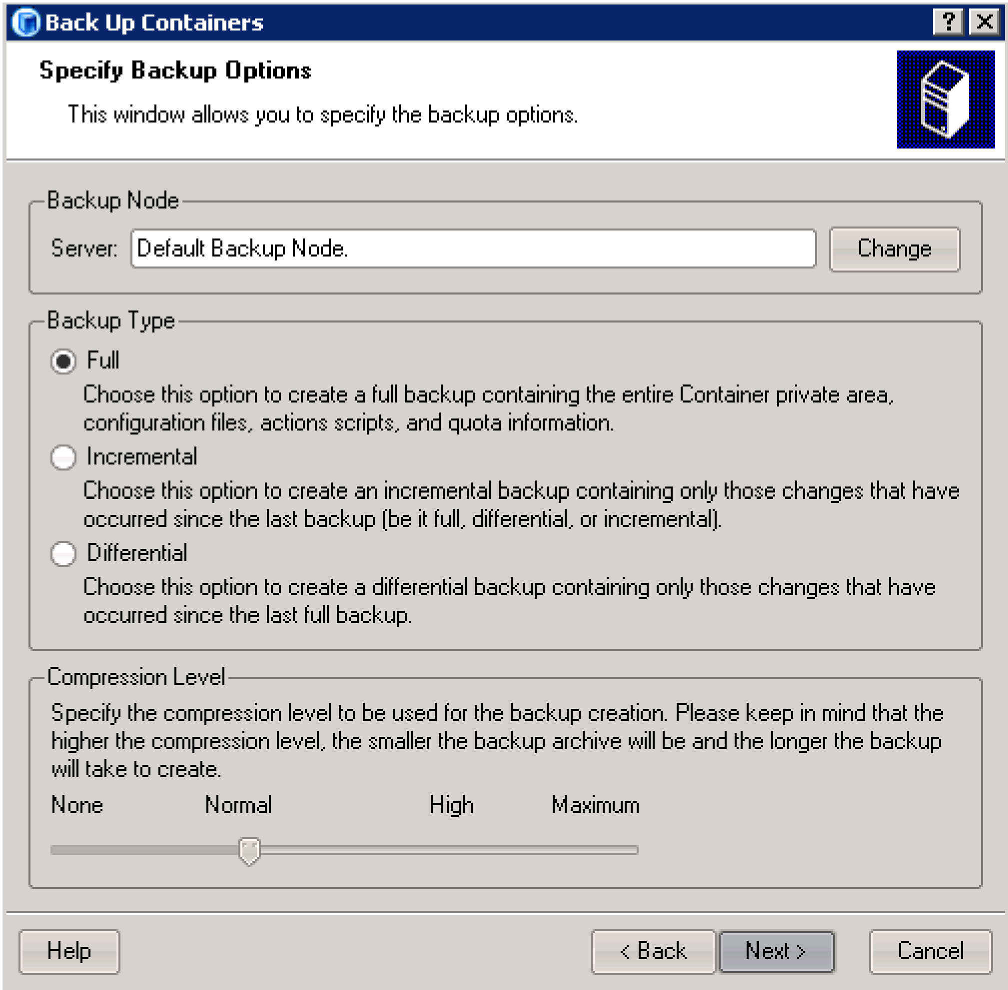

Figure 26: Management Console - Specifying Main Backup Parameters

In this window you can configure the following backup parameters:

- *Backup Node*. This Node is the place where the Container backup will be stored. You may leave the Backup Node offered by Parallels Management Console by default or use the **Change** button to specify the desired Backup Node. For detailed information on Backup Nodes, please consult the **Assigning Default Backup Node** subsection (p. 72).
- *Backup compression level*: 'None', 'Normal', 'High', or 'Maximum'. Detailed information on all compression levels is provided in the **Defining Default Compression Level** subsection (p. 75).
- *Backup type*. It may be full, incremental, or differential. Detailed information on backup types is provided in the **Specifying Default Backup Type** subsection (p. 77). If you are backing up a single Container, and no backup of this Container has been found on the Backup Node, the **Backup Type** group is not shown, and a full backup is automatically created.

5 On the next step of the wizard, you can set the following parameters for the Container backup:

- Provide the backup description in the Backup description field, if necessary. The description can be any text containing any backup-related information (e.g. the backup purpose).
- Do not stop the Container backup even if any errors appear (the Do not stop on errors check box is selected) or break the backup process should any malfunction occur (the check box is cleared).
- Do not stop the backup process if one or more of the Containers to be backed up is not present on the Source Node (the Ignore non-existent Containers check box is selected) or break the backup process if any Container is absent (the check box is cleared). This option can be used when backing up several Containers at once.

6 Review the information provided by you on the previous steps of the wizard. Click Finish to start creating the Container backup or click Back to return to any step and correct the corresponding parameters.

Another way of backing up a number of Containers from the given Source Node is the following:

1 Expand the *Source Node* item in the left pane of the Management Console main window and click the Virtuozzo Containers item to open the Containers manager window.

2 Select the Containers you wish to back up. Use the CTRL and SHIFT keys for selecting a number of Containers.

3 Click the right mouse button and select Back up Containers on the context menu.

The aforementioned Back Up Containers wizard is opened directly at the second page, because the first page (Choose Containers to Back Up) becomes unnecessary.

Browsing Backup Contents

Parallels Management Console allows you to browse the directory structure of any Container backup as if this backup had already been restored and restore only the needed files and directories, if necessary. To view the backed up files and directories of a Container backup, you should do the following:

1 Choose the **Backups** item in the Management Console right pane, right-click the Container backup whose contents you wish to browse, and select **Properties** on the context menu.

2 In the displayed window, select the corresponding backup in the **Available backups** table and click the **Show Backup Contents** button at the bottom of the window:

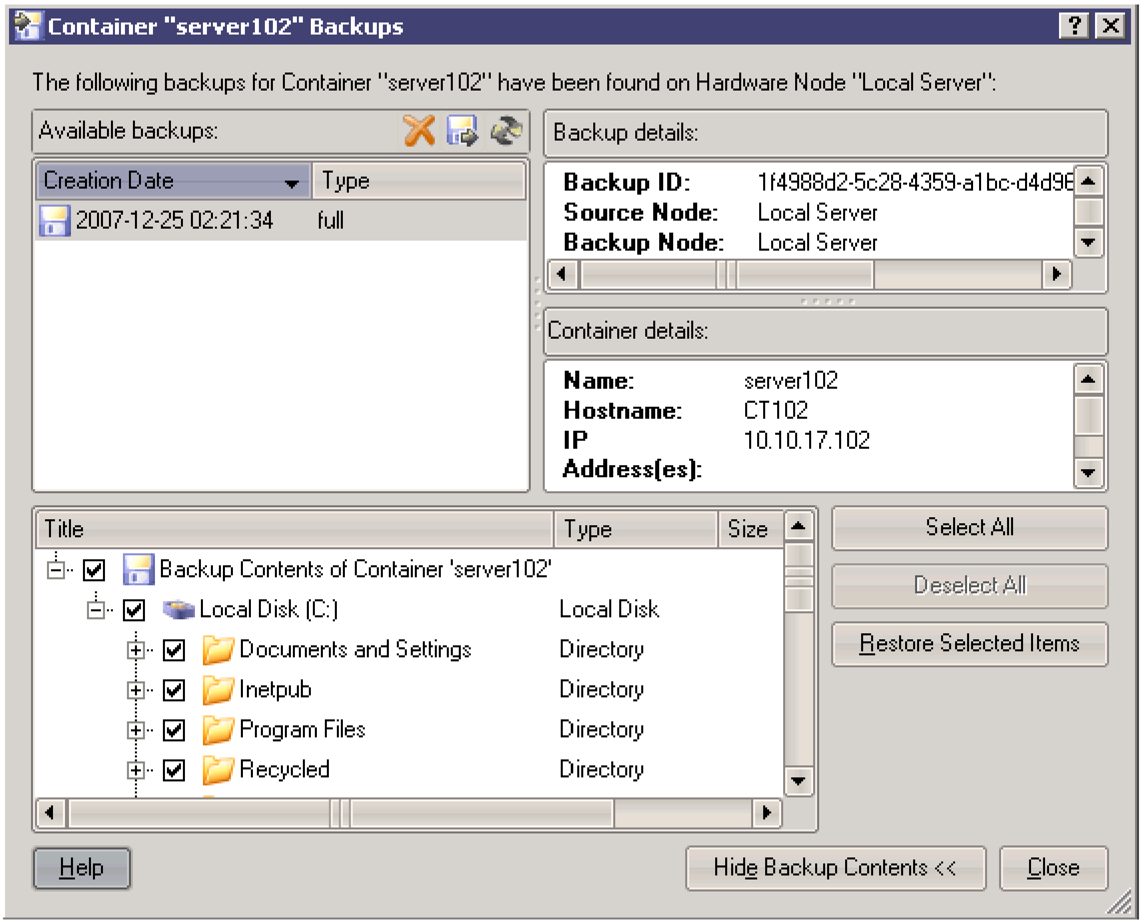

Figure 27: Management Console - Browsing Backup Contents

3 Double-click the directory to see its contents. The information on any file/directory inside the backup is presented in the table having the following columns:

Column Name	Description
Title	The name of the file/directory.
Type	Denotes whether the object is a file, directory, or Virtuozzo file link (i.e. a link to the corresponding file on the Node).
Size	The size of the file.
Modified	The date and time of the last modification of the file/directory.

If you wish to restore any files and/or directories from the backup to the actual Container, select the check boxes near the corresponding files/directories and click the Restore Selected Items button. Detailed information on how to restore individual files/directories is provided in the Restoring Container Files subsection.

Restoring Single Container

To restore a Container from its backup, do the following:

1 Expand the *Source Node* item in the left pane of the Parallels Management Console main window and click the Virtuozzo Containers item to open the Containers manager window.

2 Select the Container the backup of which you wish to restore from the Backup Node.

3 Click the right mouse button and select Backup --> Restore Container on the context menu.

The Restore Container wizard opens:

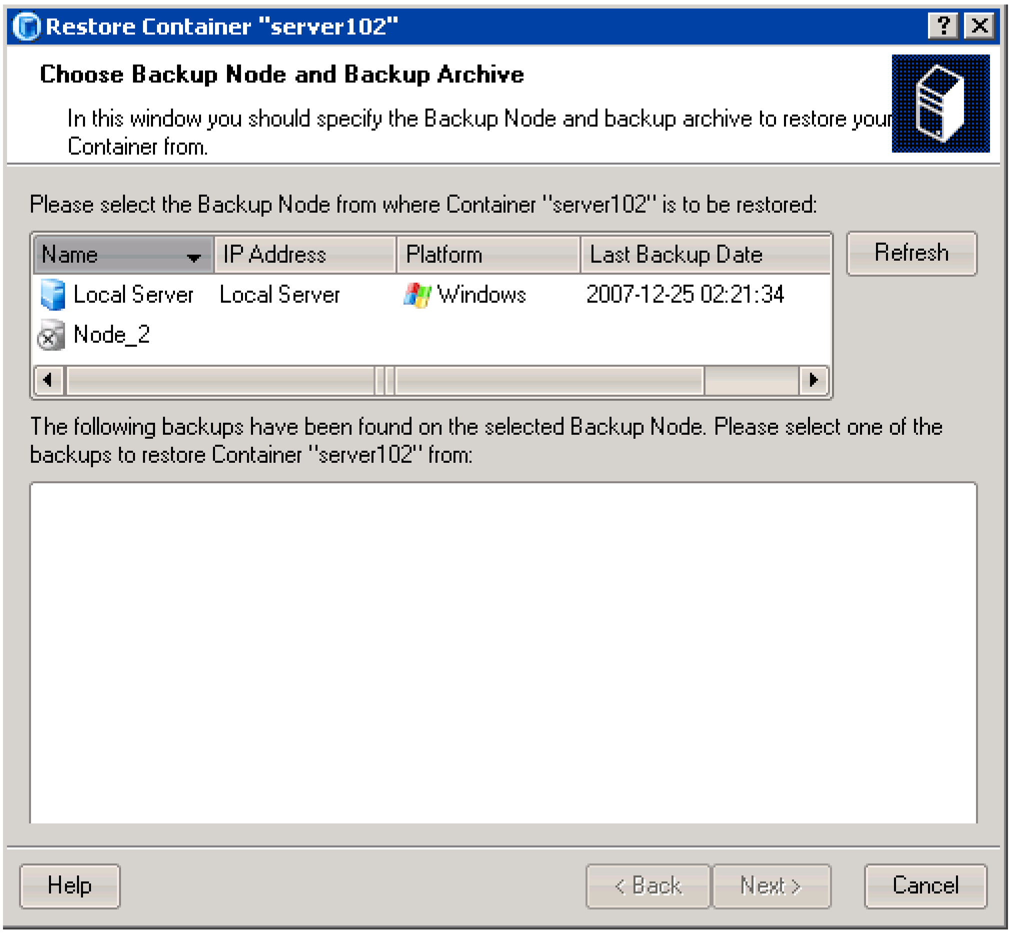

Figure 28: Management Console - Restoring Container Wizard

In this wizard you should do the following:

- In the Choose Backup Node and Backup Archive window:
  - Select the Backup Node. This Node is the place where the Container backup is stored. The Last Backup Date column in the list of Backup Nodes shows the date and time of the last backup (if any) of the selected Container on the corresponding Node.

    - Select the backup from which the Container is to be restored. Any Container may have any number of its backups made at different dates and of different types. As a rule, you choose the most recent backup, unless you have reasons to restore an intermediary one.
- In the Review Container Restoration Settings window:
    - Review the parameters provided by you on the previous step of the wizard.
    - Click the Finish button to start restoring the Container.

Notes: 1. During this operation, the Destination Node is supposed to be the same as the Source Node. For instructions on how to restore a Container to a Destination Node other than the Source Node, see Managing Backup Node.

2. If you wish to restore a Container residing on a Hardware Node running Virtuozzo Containers 4.0 from its backup stored on a 3.0 Hardware Node in Parallels Management Console, you should invoke the Restore Container wizard for the Node where the Container backup is located, i.e. for the 3.0 Node.

Restoring Container Files

Parallels Virtuozzo Containers allows you to browse the directory structure of any Container backup as if this backup had already been restored and restore only the needed files and folders/directories. To this effect, you should do the following:

1 Expand the *Source Node* item in the left pane of the Management Console main window and click the **Virtuozzo Containers** item to open the Containers manager window.

2 Right-click the Container the files/folders of which you wish to restore and select **Backup --> Restore Individual Container Files** on the context menu. The **Restore Individual Container Files** wizard opens:

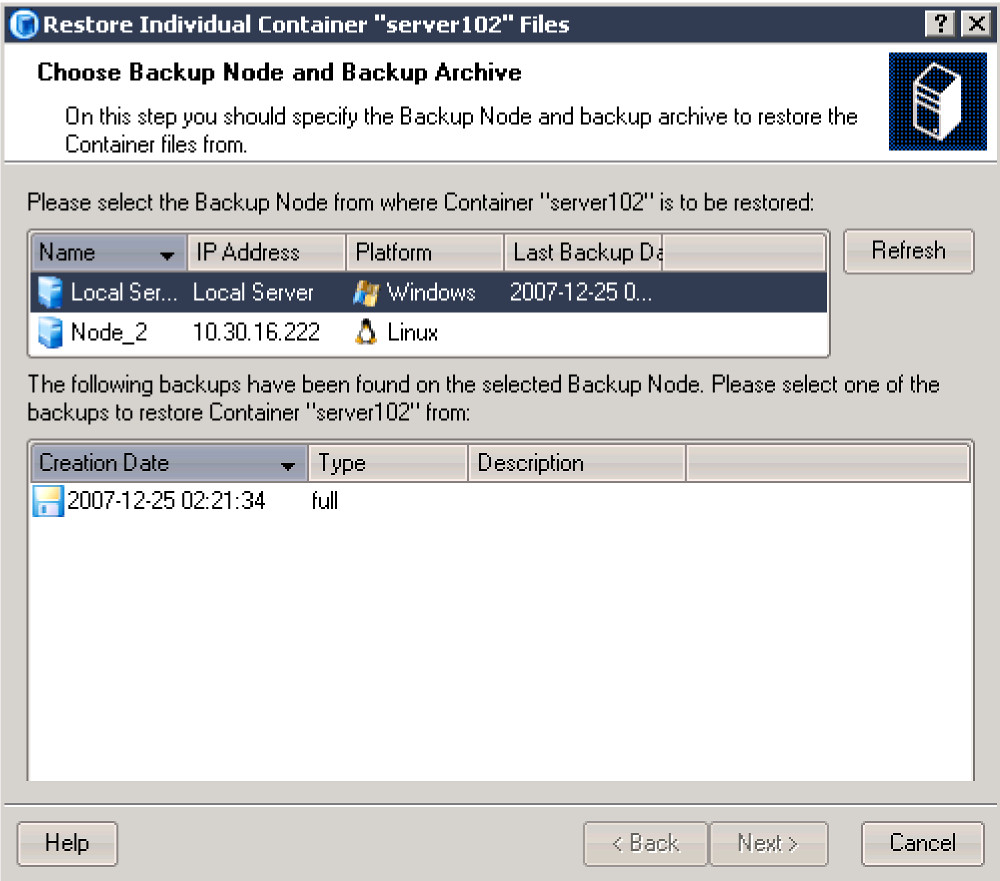

Figure 29: Management Console - Restoring Container Files Wizard

In the first step of the wizard, you should:

- Select the Backup Node. This Node is the place where the Container backup is stored. The **Last Backup Date** column in the list of Backup Nodes shows the date and time of the last backup (if any) of the selected Container on the corresponding Node.
- Select the backup from which the Container files/folders/directories are to be restored. Any Container may have any number of its backups made at different dates and of different types.

The second step of the wizard allows you to review and explore the contents of all the directories that were present inside your Container at the moment of the backup creation:

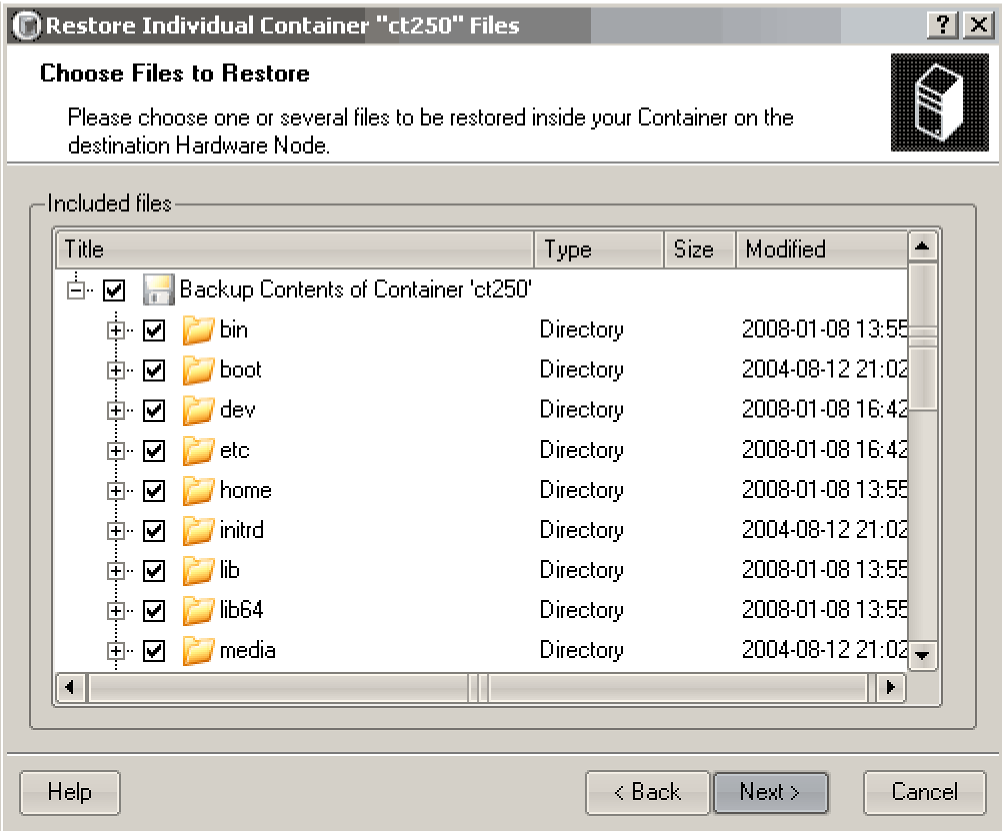

Figure 30: Management Console - Restoring Container Files Wizard

Double-click the directory to see its contents. The information on any file/directory inside the backup archive is presented in the table having the following columns:

Column Name	Description
Title	The name of the file/directory.
Type	Denotes whether the object is a file, directory, or Virtuozzo file link (i.e. a link to the corresponding file on the Node).
Size	The size of the file.
Modified	The date and time of the last modification of the file/directory.

To enqueue this or that file/directory for being restored, you should select its check box. You can restore all the files and subdirectories included in a given directory by selecting the check box next to this directory.

The last step of the wizard allows you to review the parameters provided by you on the previous steps of the wizard. If you are satisfied with the specified parameters, click **Finish** to start restoring the Container files/folders/directories; otherwise, click **Back** and change the corresponding parameters.

Note: During this operation, the Destination Node is supposed to be the same as the Source Node. For instructions on how to restore Container files/folders/directories to a Destination Node other than the Source Node, see Managing Backup Node.

Restoring Group of Containers

To restore several Containers of a single Source Node from their backups on the Backup Node, right-click the **Virtuozzo Containers** item under the corresponding *Source Node*, and select **Backup --> Restore Containers** on the context menu. The **Restore Containers** wizard is displayed. In this wizard you should:

1. Select the Backup Node on the **Choose Backup Node** screen. This Node is the place where the backups of the Source Node Containers are stored. The **Backup Availability** column in the list of Backup Nodes shows whether backups have been found on the corresponding Node.
2. On the **Choose Containers to Restore** screen, select the Containers you wish to restore from the Backup Node:

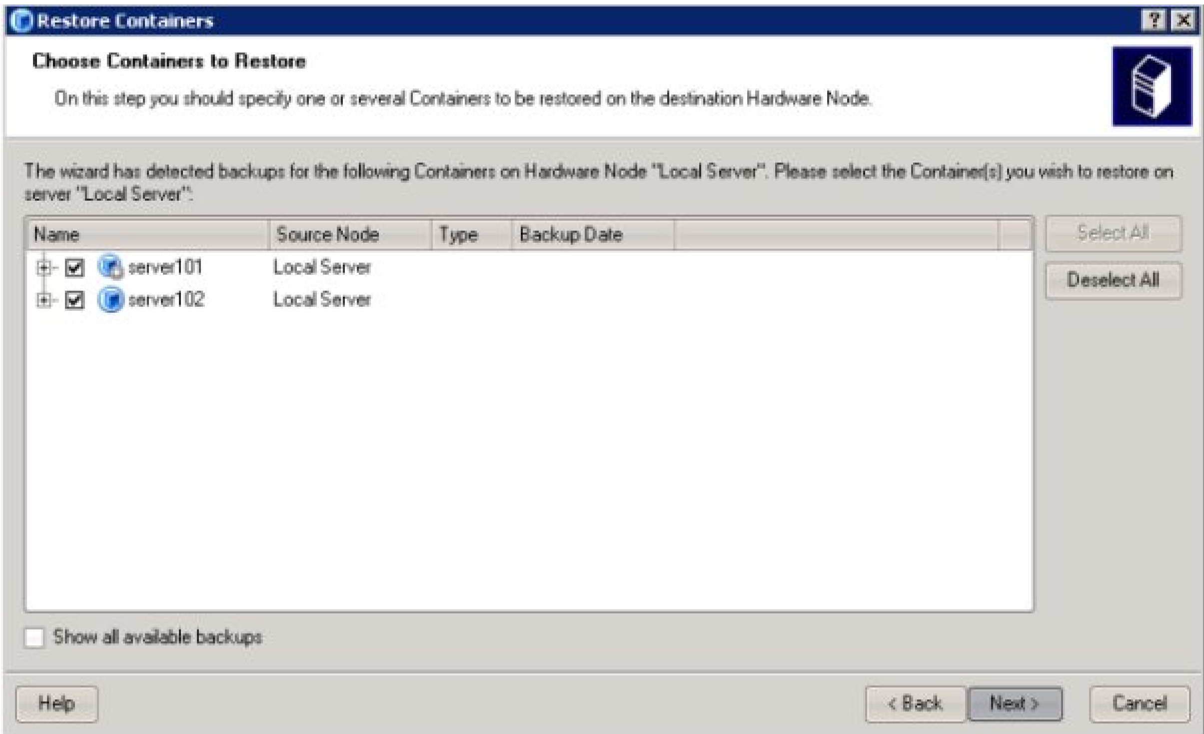

Figure 31: Management Console - Restoring Containers Wizard

By default, all the backups of the Containers originally belonging to the Source Node are selected, but you may exclude certain Containers from this list, as well as include in it any other backups found on this Backup Node (i.e. the backups of those Containers not belonging to the Source Node). To include these other backups, you should first make them visible by selecting the **Show all available backups** check box.

3 If the Containers to be restored exist on the Destination Node, you will be presented with the Resolve Conflicts With Existing Containers window listing these Containers. When deciding on whether to restore this or that Container, please keep in mind that, during the Container restoration, all its current data will be overridden with data from the corresponding backup.

4 On the Review Containers Restoration Settings screen, click the Finish button to start restoring the Containers.

Notes: 1. During this operation, all the Containers will be restored to the Source Node, i.e. to the Node for which you have invoked the wizard, irrespective of whether the backed up Containers originally belonged to this Source Node or to any other Node.

2. If you wish to restore a Container residing on a Hardware Node running Virtuozzo Containers 4.0 from its backup stored on a 3.0 Hardware Node in Parallels Management Console, you should invoke the Restore Container wizard for the Node where the Container backup is located, i.e. for the 3.0 Node.

Managing Backup Node

Any Hardware Node may perform the functions of the Backup Node, i.e. store the backups of any Containers of any Hardware Nodes. To see a list of Container backups stored on a Hardware Node, expand its name in the left pane of the Management Console main window and select the **Backups** item:

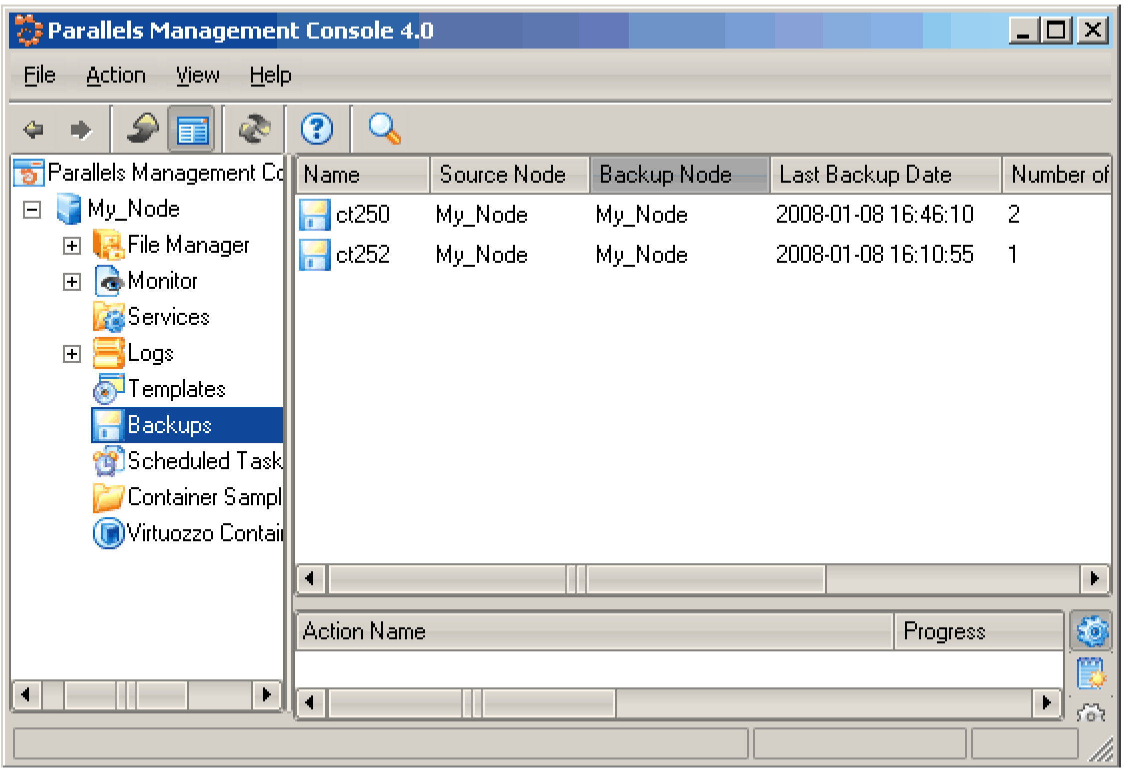

Figure 32: Management Console - Listing Backups

The table in the right pane presents the following information about the Container backups stored on the current Backup Node:

Column Name	Description
Name	The name of the backed up Container.
Source Node	The Node where the Container was hosted during its backing up.
Last Backup Date	The date and time when the last backing up of the Container took place.
Number of Backups	The number of Container backups on the Node.
Description	The backup description.

The backup manager window allows you to perform the following operations:

- Restore a single Container from its backup. You should right-click the needed Container backup and select Restore Container on the context menu to start the Restore Container wizard. In this wizard, you should select the Destination Node, i.e. the place whither the Container will be restored. By default, the Container Source Node is selected. Only the Nodes registered in Parallels Management Console are shown.
- Restore one or several files and/or directories from a particular Container backup. You should right-click the Container backup whose files/directories you wish to restore and select Restore Individual Container Files on the context menu to start the Restore Individual Container Files wizard. In this wizard you should:
  - Select the Destination Node, i.e. the place whither the Container files/directories will be restored:

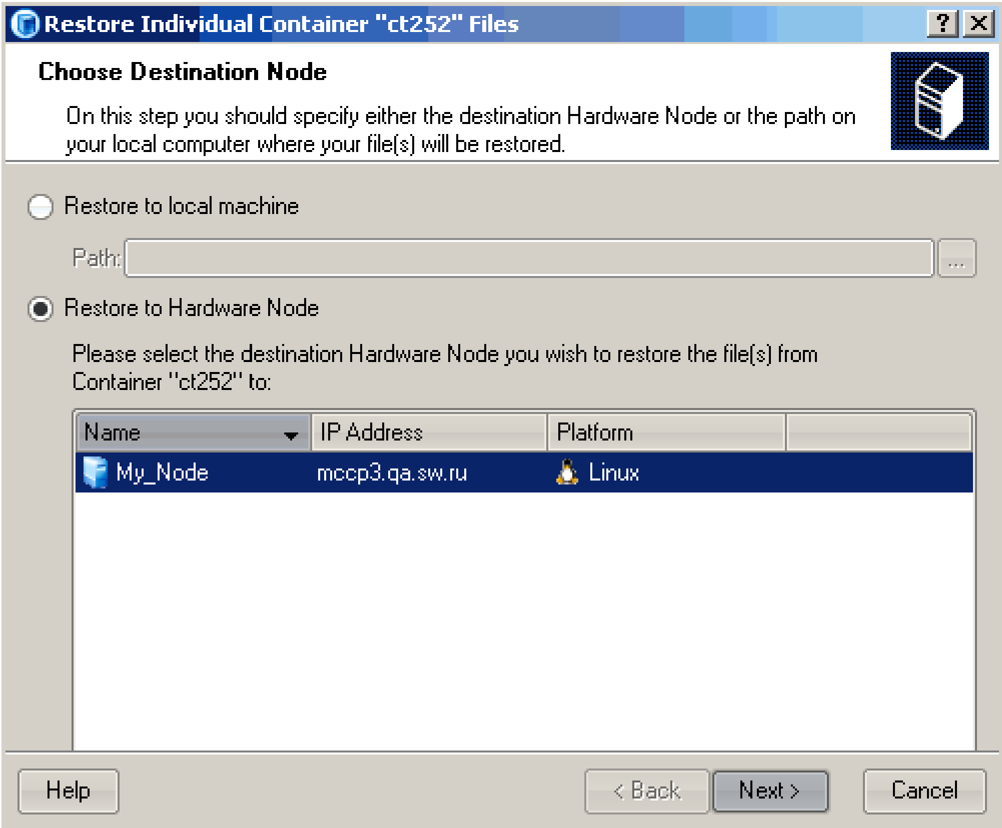

Figure 33: Management Console - Launching Restore Individual Container Files Wizard

By default, the Container Source Node is selected. Only the Nodes registered in Parallels Management Console are shown. You can also restore the files to your local computer, i.e. to the computer where Parallels Management Console is installed. To this effect, select the Restore to local machine radio button and, in the Path field, specify the path to the folder whither the files will be restored.

- Select the Container files/directories that will be restored to the Destination Node:

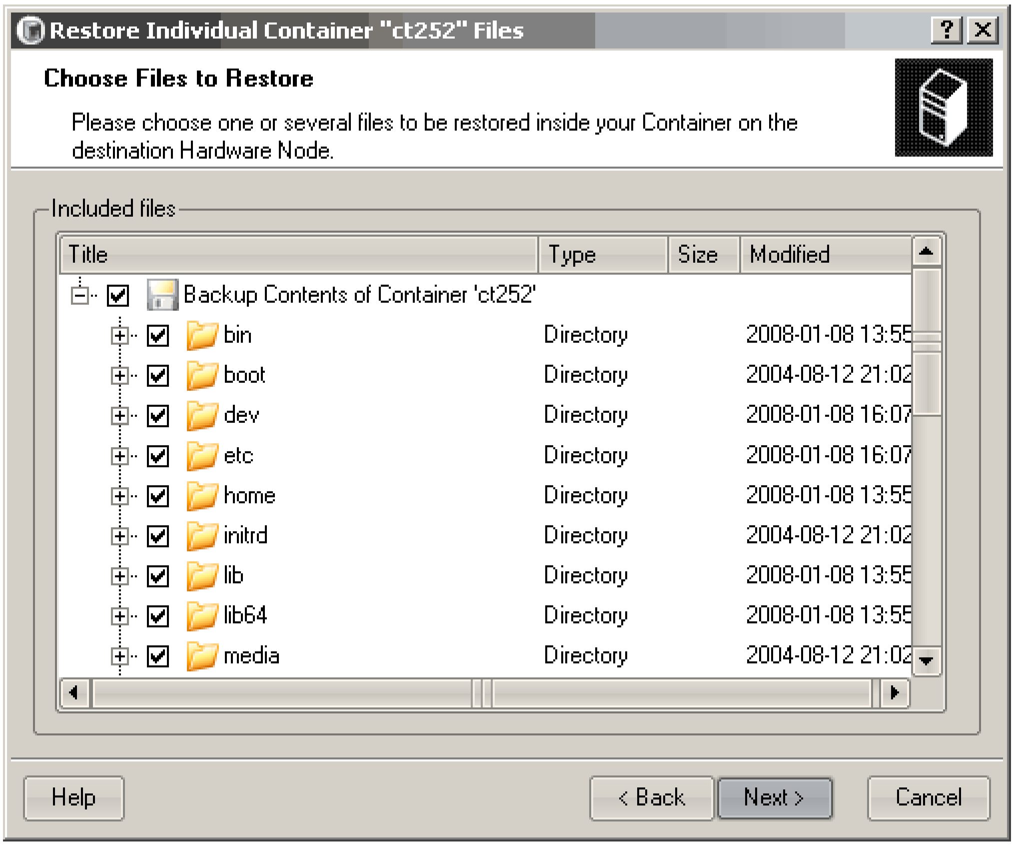

Figure 34: Management Console - Choosing Files For Restoring

The Choose Files to Restore window provides you with a tree view of the files and directories that you have backed up. To enqueue this or that file/directory for being restored, you should select its check box. You can select the check box next to the corresponding directory to restore all the files and subdirectories from this directory.

- The Review Container Restoration Settings window enables you to review the parameters entered by you on the previous steps of the wizard. If you are satisfied with the parameters set, click Finish to start restoring the selected Container files/directories to the Destination Node. Otherwise, click Back and change the corresponding parameters.

Right-clicking on a Container backup in this table and selecting Properties on the context menu brings about the Container Backups dialog where you can view extensive information about the current Container backup, including all its full and incremental backups, as well as delete any of these backups, explore their contents (i.e. the Container files and directories), or restore the Container or any of its files/directories by selecting their check boxes and clicking the Restore Selected Items button.

Searching for Container Backups

If you do not remember the place where you are storing the backup of a particular Container (identified by its ID or its IP address or its hostname or by the date of its creation), you can search for the backup across all the Hardware Nodes (performing the function of Backup Nodes in this case) registered in Parallels Management Console.

To search for a backup, do the following:

1 Right-click the Virtuozzo Containers item under the corresponding Backup Node name, and select Backup --> Search for Backups on the context menu to open the Find Container Backups dialog:

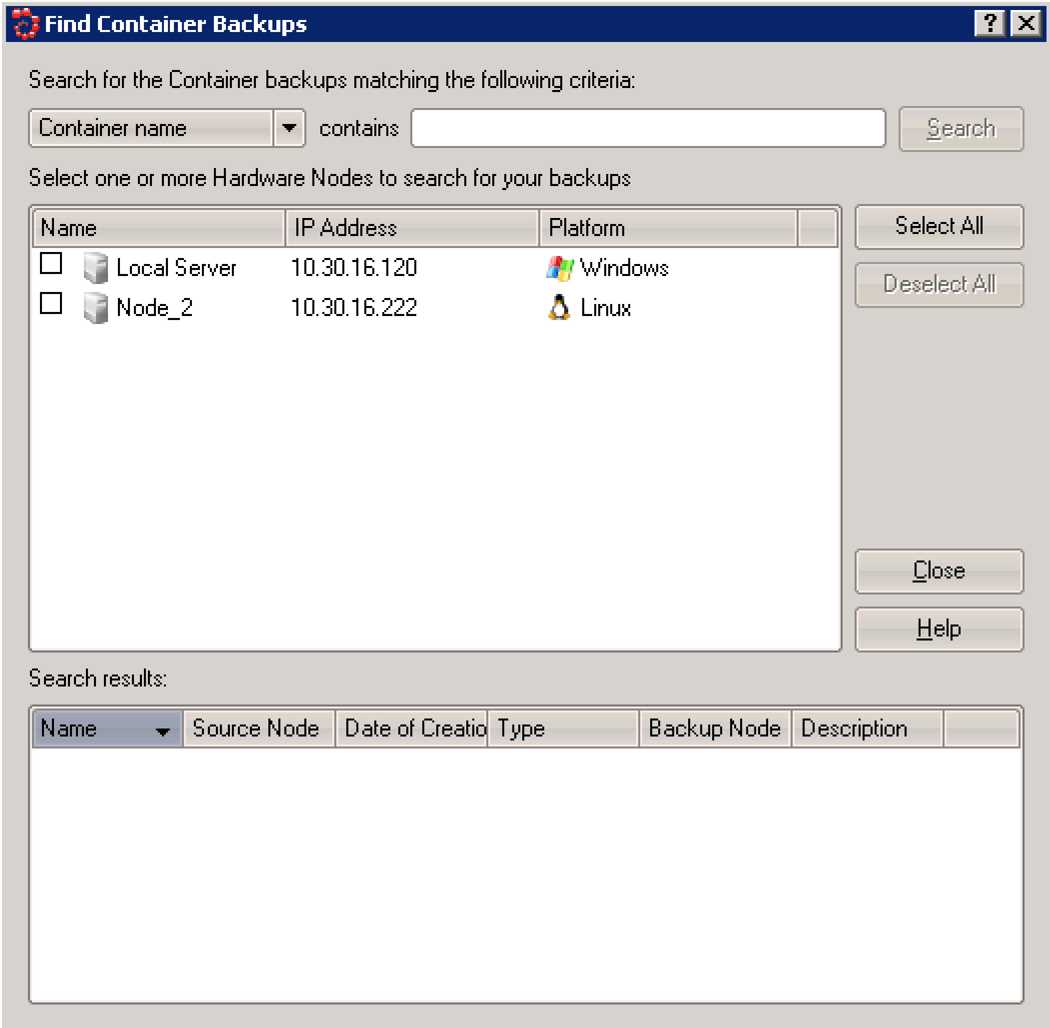

Figure 35: Management Console - Searching for Backups

2 On the upper left drop-down menu, choose the Container parameter by which you wish to search for the corresponding Container backup.

3 Enter the value of the parameter in the text field on the right. All the Containers with the corresponding parameter including the specified value as its part will be found. E.g., if you enter "100" as the value for Container ID, the backups of Containers 100, 1000, 1001, 1002, 2100, 3100, and so on, will be searched for.

4 Check those Nodes where you want to search for the backups.

5 Click the Search button.

The Search results table presents the following information about the found backups:

Column Name	Description
Name	The name of the Container whose backup has been found.
Source Node	The Node where the Container was hosted during its backing up.
Creation date	The date and time when the backup was created.
Type	The backup type. Detailed information on all backup types is given in the Defining Default Backup Type subsection (p. 77).
Backup Node	The Backup Node - the Node where the backup has been found.
Description	The backup description.

Double-clicking on a Container backup in this table brings about the Container Backups dialog where you can view extensive information about the current Container backup, including all its full and incremental backups, as well as delete any of these backups or restore them in the manner depicted above.

Scheduling Container Backups

Parallels Management Console allows you to automate the task of backing up your Containers by setting Container backups to be run on a schedule. So, you can specify certain time intervals when the Container backup will be automatically performed. A schedule can be set for a Container to be backed up at different intervals: daily, weekly, monthly. It is also possible to specify a particular day of month for a Container backup to be executed.

Parallels Management Console provides you with a special wizard - Schedule Task for Backing Up Containers - helping you schedule the time when for your Containers are to be backed up. To invoke the wizard, right-click the Scheduled Tasks item under the corresponding Hardware Node name and select Schedule New Task --> Back Up Containers on the context menu.

In this wizard you should:

1 Choose the Containers to be backed up on the schedule you will set on the following steps of the wizard.To this effect, click the Add button in the top right corner of the Choose Containers to Backup Up window, select the names of the corresponding Containers, and click OK. When you are read, click Next to proceed with the wizard.

2 Choose the Container backup mode:

- Default: select this radio button to back up the Container using the default backup mode. When run in this mode, the default backup parameters are used for creating the Container backup. You can only set the backup description and configure the default backup policy.

Note: Detailed information on what default backup parameters are and how to manage them is given in the Setting Default Backup Parameters subsection (p. 72).

- Custom: select this radio button to manually set the parameters to be applied to the resulting backup archive. In this case you will have to go through a number of additional steps (Steps 3 and 4) of the Schedule Backup Task for Container(s) wizard and set the necessary parameters of the Container backup one by one.

3 Specify the files and directories to be included in the backup:

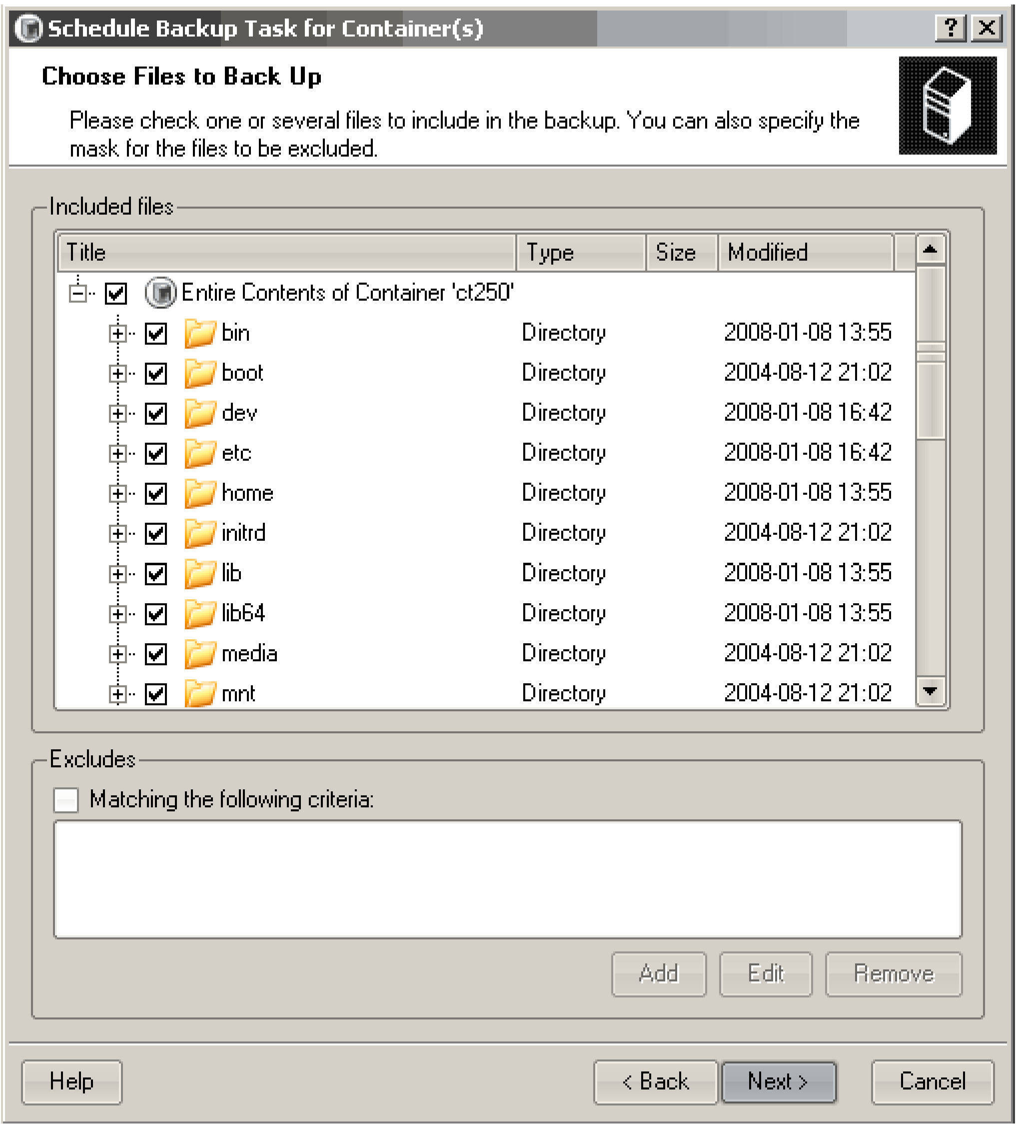

Figure 36: Scheduling Container Backups - Choosing Files to Back Up

By default, all the Container files and folders are included in the backup archive. To leave out a file or directory from the backup process, clear its check box in the **Included files** table. You can also select the **Matching the following criteria** check box and use the **Add**/**Edit**/**Remove** buttons to set the parameters to be met by the file/folder to exclude it from the backup process. You can specify the full path to the corresponding file/folder, enter its name, or define any filter compatible with standard Linux masking rules (i.e. with standard globs). For example, you can indicate `/usr/MyDirectory/MyFile.txt` to exclude the `MyFile.txt` file from the backup process or type `*.bmp` to leave out all files with the `bmp` extension.

Note: The **Included files** table is not shown if you are creating a backup task for several Containers.

---

4 Next you should specify the main backup parameters:

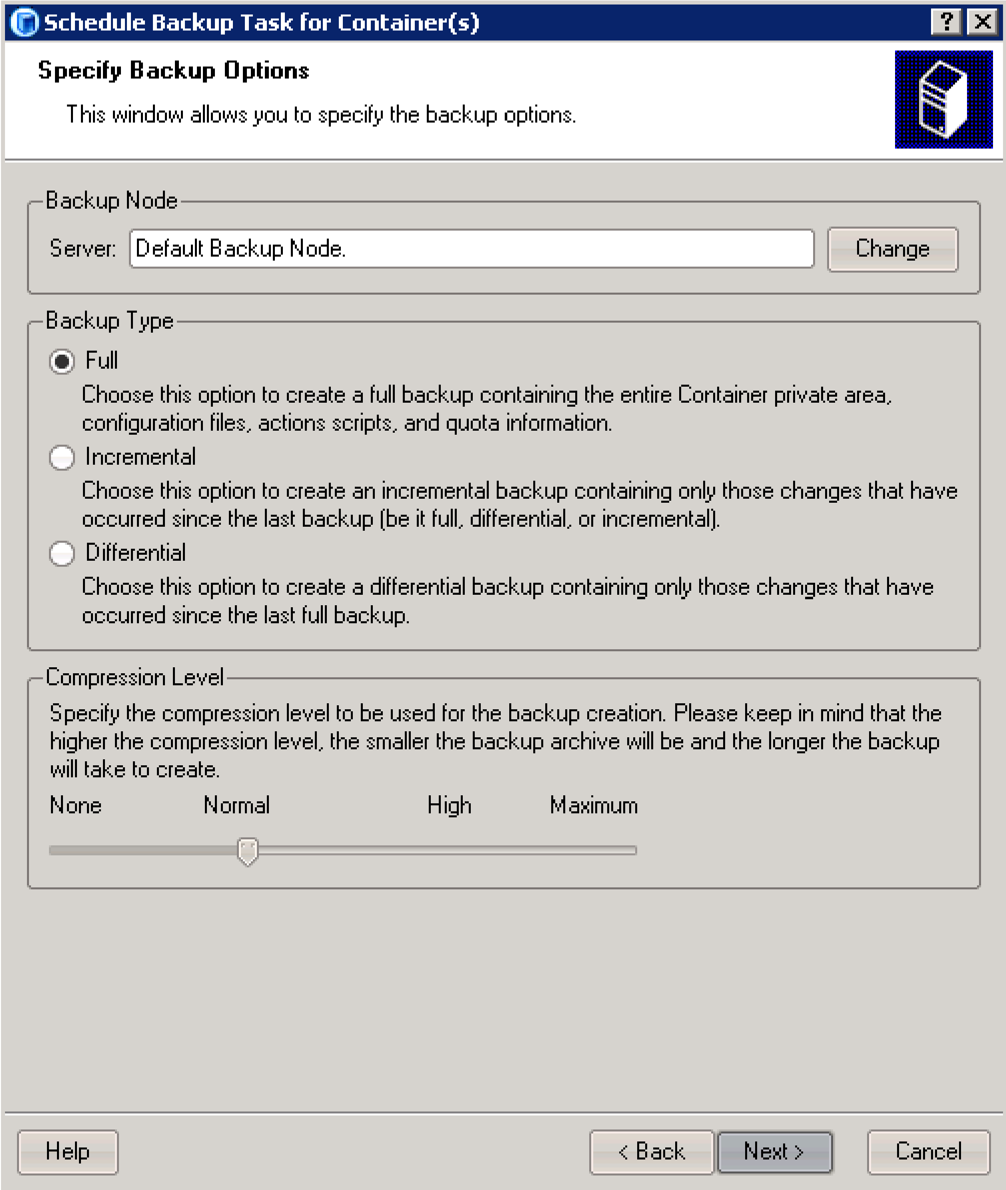

Figure 37: Scheduling Container Backups - Setting Main Backup Options

In this window you can configure the following backup parameters:

- *Backup Node*. This Node is the place where the Container backup will be stored. You may leave the Backup Node offered by Parallels Management Console by default or use the **Change** button to specify the desired Backup Node. For detailed information on Backup Nodes, please consult the **Assigning Default Backup Node** subsection (p. 72).
- *Backup compression level*: 'None', 'Normal', 'High', or 'Maximum'. Detailed information on all compression levels is provided in the **Defining Default Compression Level** subsection (p. 75).

- *Backup type*. It may be full, incremental, or differential. Detailed information on backup types is provided in the Specifying Default Backup Type subsection (p. 77). If you are backing up a single Container, and no backup of this Container has been found on the Backup Node, the Backup Type group is not shown, and a full backup is automatically created.

5 On the next step of the wizard, you can set the following parameters for the Container backup:

- Provide the backup description in the Backup description field, if necessary. The description can be any text containing any backup-related information (e.g. the backup purpose).
- Do not stop the Container backup even if any errors appear (the Do not stop on errors check box is selected) or break the backup process should any malfunction occur (the check box is cleared).
- Do not stop the backup process if one or more of the Containers to be backed up is not present on the Source Node (the Ignore non-existent Containers check box is selected) or break the backup process if any Container is absent (the check box is cleared). This option can be used when backing up several Containers at once.

6 Next you should specify a number of parameters for the backup tasks being created:

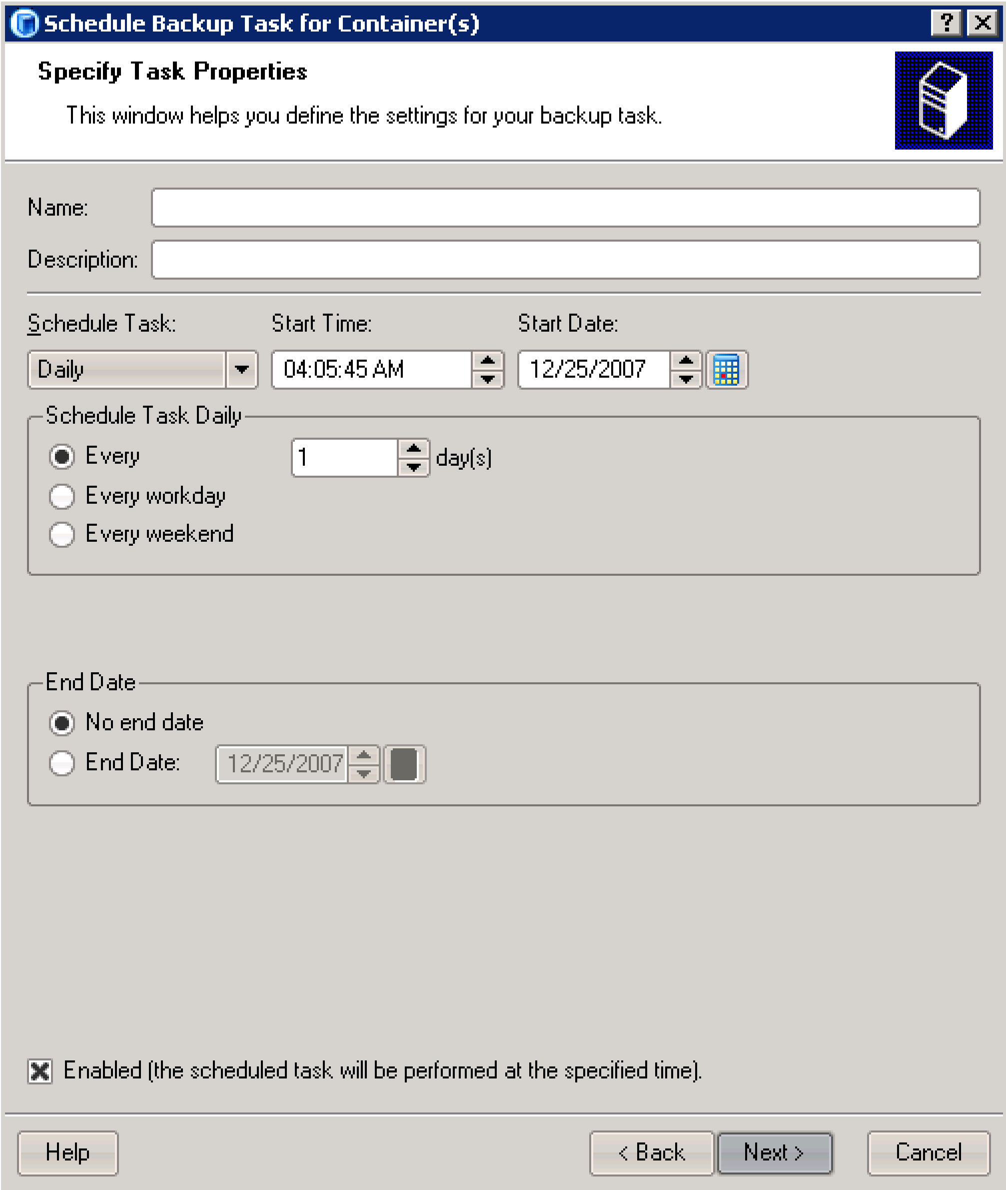

Figure 38: Management Console - Defining Backup Tasks Parameters

In this window you are supposed to:

- set the name for the backup task;
- provide the task description, if necessary;
- set the schedule for the Container backup (specify the task start time, set the time interval when the Container backup is to be performed, etc.);
- define the date when the backup task is to be removed from the schedule.

You can also clear the Enabled ... check box if you wish to run the scheduled task during a certain period of time. You can always enable the task later on by right-clicking the task and selecting Enable on the context menu.

7 On the last step of the wizard, review the parameters provided by you on the previous steps of the wizard. If you are satisfied with all the parameters, click **Finish** to schedule the task. Otherwise, click the **Back** button to return to the previous steps and change the corresponding parameters. On this step you can also do the following:

   - Provide the backup description in the **Backup description** field. The description can be any text containing any backup-related information (e.g. the backup purpose).
   - Select the **Do not stop on errors** check box to make the Container backup not stop even if any errors appear during the backup execution. If you clear the check box, the backup process will be broken should any malfunction occur.
   - Select the **Force full backup** check box to always perform a full backup for the selected Containers. If you clear the check box, an incremental backup will be performed for those Containers whose full backups are already present on the Backup Node.

At any time, you can configure any parameters of the scheduled backup task, disable the task, or even delete it. To this effect, choose the **Scheduled Tasks** item under the corresponding Hardware Node name, right-click the corresponding backup task in the Management Console right pane, and select one of the following options on the context menu:

- **Disable** to temporarily stop backing up your Containers on the set schedule
- **Delete** to permanently remove the scheduled backup task
- **Properties** to change the settings of the backup task.

Setting Maximal Backup Number for Parallels Power Panel

Management Console allows you to configure the number of Container backups Container administrators are allowed to create on the given Hardware Node using Parallels Power Panel. By default, any Container administrator is allowed to create only one Container backup in Parallels Power Panel. However, you can increase the number of allowed backups by performing the following operations:

1 Right-click the Hardware Node where the Container, for which you wish to increase the number of allowed backups, is residing and choose Backup --> Set Default Backup Options:

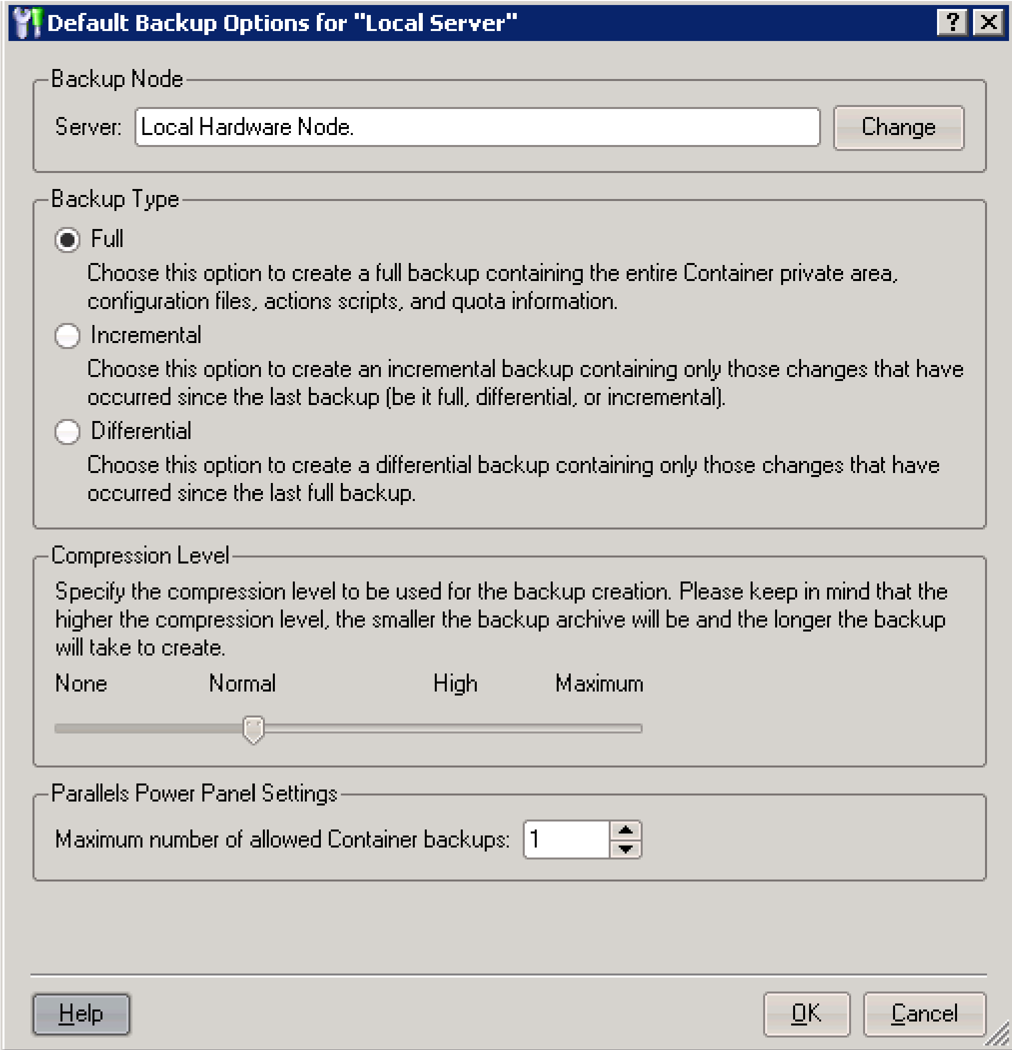

Figure 39: Management Console - Setting Number of Allowed Backups in Power Panel

2 Specify the number of Container backups the Container administrator will be able to create with Parallels Power Panel by typing the desired number in the Maximum number of allowed Container backups field or using the spin button.

3 Click OK.

Please keep in mind that the limit set on the number of Container backups concerns only the process of backing up Containers using the Parallels Power Panel tool. There are no restrictions for any users creating Container backups by means of other Virtuozzo Tools (e.g. Parallels Infrastructure Manager or Parallels Management Console); they are allowed to create as many Container backups as they want to.

Reinstalling Container

Reinstalling a Container is used if a Container administrator has inadvertently modified, replaced, or deleted any file that is part of an application or OS template, which has brought about the Container malfunction. You can reinstall the Container in the two following ways:

1 The `vzctl recover` command restores the original VZFS symlinks of the Container private area to the OS and/or application template(s) as they were at the time when the Container was created and/or when the application template(s) were added to the Container. This command does not deal with any user files on the Container:

```
# vzctl recover 101
Optimizing Container private area...
vzquota : (warning) Quota is running for id 101 already
Setting quota ...
Container is mounted
Setup slm memory limit
Setup slm subgroup (default)
Container is unmounted
Recover OS template: redhat-el5-x86
Creating Container private area (redhat-el5-x86)
...
Recovering Container completed successfully
```

2 The `vzctl reinstall` command creates a new private area for the problem Container from scratch using its configuration files and its OS and application templates. Thus, a clean working copy of the Container is created:

```
# vzctl reinstall 101
Optimizing Container private area...
Calculating Container disk usage...
Creating Container private area (redhat-el5-x86)
Starting Container ...
Initializing quota...
Container is mounted
Setup slm memory limit
Setup slm subgroup (default)
Container start in progress...
Calculating Container disk usage...
Copying Container credentials...
Stopping Container ...
Container was stopped
Container is unmounted
Old Container file system has been moved to /old
Initializing quota...
Container reinstallation completed successfully
```

Note: If any of the Container application templates cannot be added to the Container in a normal way, the reinstallation process will fail. This may happen, for example, if an application template was added to the Container using the `--force` option of the `vzpkgadd` or `vzpkg install` command (for more information on these commands, please see the Virtuozzo Command Line Interface chapter in the Parallels Virtuozzo Containers Reference Guide).

In order to retain the personal data inside the old Container, the utility also copies the contents of the old private area to the `/old` directory of the new private area (unless the `--skipbackup` option is given). The personal data can then be copied to the corresponding directories of the new private area and the `/old` directory eventually deleted:

```
# vzctl start 101
Starting Container ...
```

```
Container is mounted
Setup slm memory limit
Setup slm subgroup (default)
Setting devperms 20002 dev 0x7d00
Adding port redirection to Container(1): 4643 8443
Adding IP address(es) to pool:
Adding IP address(es): 10.14.14.101
Hostname for Container set: localhost.localdomain
Container start in progress...
# vzctl exec 101 ls /
bin
boot
dev
[...other directories...]
old
[...other directories...]
tmp
usr
var
```

Both the `vzctl recover` and `vzctl reinstall` commands retain the users' credentials base, unless the `--resetpwdb` option is specified.

Note: In the current version of Parallels Virtuozzo Containers, Management Console does not support recovering Containers; this functionality is accessible only through the command line on the Hardware Node.

Customizing Container Reinstallation

The default reinstallation, as performed by the `vzctl reinstall` command, creates a new private area for the broken Container as if it were created by the `vzctl create` command and copies the private area of the broken Container to the `/old` directory in the new private area so that no file is lost. There is also a possibility of deleting the old private area altogether without copying or mounting it inside the new private area, which is done by means of the `--skipbackup` option. This way of reinstalling corrupted Containers might in certain cases not correspond exactly to your particular needs. It happens when you are accustomed to creating new Containers in some other way than just using the `vzctl create` command. For example, you may install additional software licenses into new Containers, or anything else. In this case you would naturally like to perform reinstallation in such a way so that the broken Container is reverted to its original state as determined by you, and not by the default behavior of the `vzctl create` command.

To customize reinstallation, you should write your own scripts determining what should be done with the Container when it is being reinstalled, and what should be configured inside the Container after it has been reinstalled. These scripts should be named `vps.reinstall` and `vps.configure`, respectively, and should be located in the `/etc/vz/conf` directory on the Hardware Node. To facilitate your task of creating customized scripts, the Virtuozzo Containers software is shipped with sample scripts that you may use as the basis of your own scripts.

When the `vzctl reinstall <CT_ID>` command is called, it searches for the `vps.reinstall` and `vps.configure` scripts and launches them consecutively. When the `vps.reinstall` script is launched, the following parameters are passed to it:

`--veid`	The ID of the Container.

`--ve_private_tmp`	The path to the Container temporary private area. This path designates where a new private area is temporarily created for the Container. If the script runs successfully, this private area is mounted to the path of the original private area after the script has finished.
`--ve_private`	The path to the Container original private area.

You may use these parameters within your `vps.reinstall` script.

If the `vps.reinstall` script finishes successfully, the Container is started, and the `vps.configure` script is called. At this moment the old private area is mounted to the `/old` directory inside the new one irrespective of the `--skipbackup` option. This is done in order to let you use the necessary files from the old private area in your script, which is to be run inside the running Container. For example, you might want to copy some files from there to regular Container directories.

After the `vps.configure` script finishes, the old private area is either dismounted and deleted or remains mounted depending on whether the `--skipbackup` option was provided.

If you do not want to run these reinstallation scripts and want to stick to the default `vzctl reinstall` behavior, you may do either of the following:

1 Remove the `vps.reinstall` and `vps.configure` scripts from the `/etc/vz/conf` directory, or at least rename them;

2 Modify the last line of the `vps.reinstall` script so that it would read

```
exit 128
```

instead of

```
exit 0
```

The `128` exit code tells the utility not to run the scripts and to reinstall the Container with the default behavior.

Deleting Container

You can delete a Container that is not needed anymore with the `vzctl destroy` *<CT_ID>* command. This command removes the Container private area completely and renames the Container configuration file and action scripts by appending the `.destroyed` suffix to them.

Note: You can also use the `vzctl delete` command introduced in Virtuozzo Containers 4.0 to remove Containers from your Hardware Node. This command has the syntax identical to `vzctl destroy` and is meant to replace the latter in the future.

A running Container cannot be destroyed with the `vzctl destroy` command. The example below illustrates destroying Container 101:

```
# vzctl destroy 101
Destroying Container private area: /vz/private/101
Container is currently mounted (unmount first)
# vzctl stop 101
Stopping Container ...
Container was stopped
Container is unmounted
# vzctl destroy 101
Destroying Container private area: /vz/private/101
Container private area was destroyed
# ls /etc/vz/conf/101.*
/etc/vz/conf/101.conf.destroyed
# vzctl status 101
VEID 101 deleted unmounted down
```

If you do not need the backup copy of the Container configuration files (with the `.destroyed` suffix), you may delete them manually.

Containers can be deleted by using Parallels Management Console. Management Console allows you to delete Containers that are not needed anymore. To delete one or more Containers, select it (them) in the **Containers** table in the right pane of the Management Console main window. You can use CTRL+Click to select or deselect an entry, SHIFT+Click to select a range of Containers, CTRL+A to select all Containers. Then right-click the selected Containers and choose **Delete**, for example:

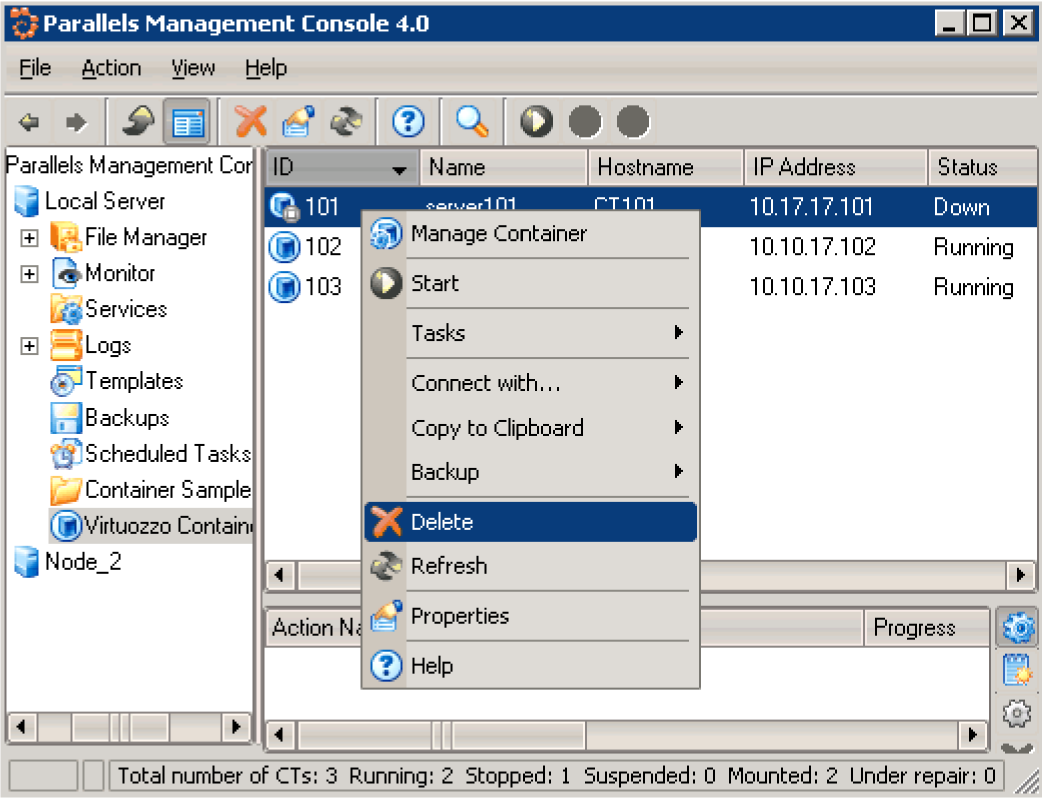

Figure 40: Management Console - Deleting Container

You can also click the **Delete** button on the toolbar or select **Delete** on the **Action** menu. In the displayed dialog, click **Yes** to confirm your decision.

Deleting a considerable number of Containers may take a rather long run. The progress is displayed in the **Actions** pane.

Disabling Container

There may appear situations when you wish to forbid Container owners to use their Containers. For example, it may happen in case the Container owner uses it for unallowed purposes: intruding into computers of other users, participating in DoS attacks, etc.

In such cases, the Virtuozzo Containers software allows you to disable a Container, thus, making it impossible to start the Container once it was stopped. For example, you can execute the following command to disable Container 101 residing on your Hardware Node:

```
# vzctl set 101 --disabled yes
```

After the Container stopping, the Container user will not be able to start it again until you enable this Container again by passing the `--disabled no` option to `vzctl set`. You can also use the `--force` option to start any disabled Container. For example:

```
# vzctl start 101
Container start disabled
# vzctl start 101 --force
Starting Container...
Container is mounted
Adding port redirection to Container(1): 4643 8443
Adding IP address(es): 10.144.144.101
Hostname for Container set: Container_101
Container start in progress...
```

You can also disable/enable a Container by means of Parallels Management Console. To this effect, you should select the **Virtuozzo Containers** item under the Hardware Node name on the Management Console main menu, right-click the corresponding Container, and choose **Tasks --> Disable/Enable** on the context menu, respectively. For example:

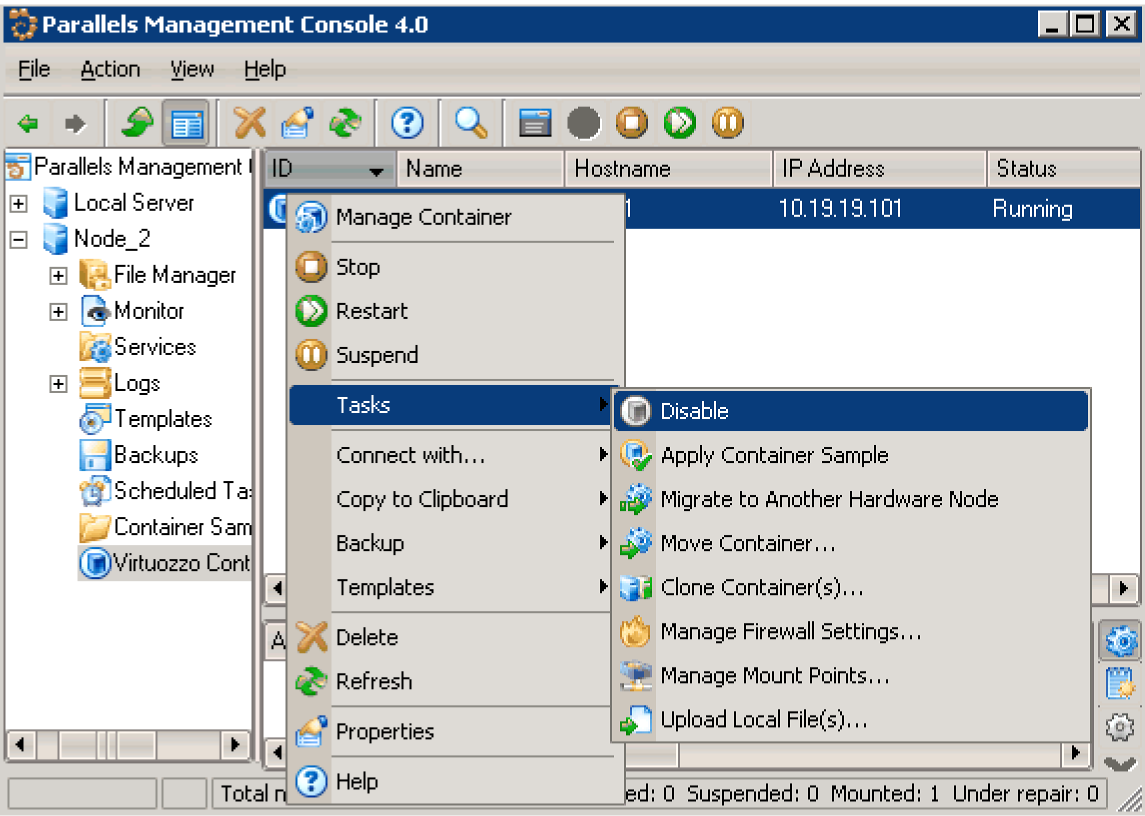

Figure 41: Management Console - Disabling Container

You can use CTRL+Click to select or deselect an entry, SHIFT+Click to select a range of Containers, CTRL+A to select all Containers.

Suspending Container

Parallels Virtuozzo Containers 4.0 allows you to suspend any running Container on the Hardware Node by saving its current state to a special dump file. Later on, you can resume the Container and get it in the same state the Container was at the time of its suspending.

In Virtuozzo-based systems, you can use the `vzctl suspend` command to save the current state of a Container. For example, you can issue the following command to suspend Container 101:

```
# vzctl suspend 101
Setup checkpoint ...
Container is unmounted
Checkpointing completed successfully
```

During the command execution, the `/vz/private/101/dump/Dump` file containing the entire state of Container 101 is created and the Container itself is stopped.

Note: You can set another directory to store dump files for your Containers by changing the value of the `DUMPDIR` parameter in the Virtuozzo global file. Detailed information on the Virtuozzo global file and the parameters you can specify in it is provided in the Parallels Virtuozzo Containers Reference Guide.

In Parallels Management Console, you can suspend a running Container by doing the following:

1 Select the Containers item under the corresponding Hardware Node name in the Management Console left pane.

2 In the Management Console right pane, right-click the Container you wish to suspend and choose Suspend on the context menu.

3 Confirm the operation execution by clicking Yes in the displayed window.

At any time, you can resume Container 101 by executing the following command:

```
# vzctl resume 101
Starting Container ...
Container is mounted
Adding port redirection to Container(1): 4643 8443
Adding IP address(es): 10.0.10.101
Container start in progress...
```

The Container state is restored from the `/vz/private/101/dump/Dump` file on the Node. Upon the restoration completion, any applications that were running inside Container 101 at the time of its suspending will be running and the information content will be the same as it was when the Container was suspended.

To restore a suspended Container in Management Console:

1 Select the Containers item under the corresponding Hardware Node name in the Management Console left pane.

2 In the Management Console right pane, right-click the Container you wish to restore and choose Resume on the context menu.

While working with dump files, please keep in mind the following:

- You can restore the Container dump file on the Source Node, i.e. on the Node where this Container was running before its dumping, or transfer the dump file to another Node and restore it there.

Note: Before restoring a Container from its dump file, please make sure that the file system on the Destination Node is identical to that at the moment of the Container dumping; otherwise, the Container restoration may fail.

- You can use the file manager to view the files and directories inside the suspended Container. However, you cannot change any of the files and directories since it may cause the Container to resume improperly.
- You can reinstall the suspended Container.
- You can back up the suspended Container.
- You can restore the suspended Container from its backup. After restoring the Container, it is brought to the 'suspended' state again.
- You cannot clone the suspended Container.
- You cannot change the ID of the suspended Container.
- You cannot change network settings of the suspended Container.
- You cannot perform operations on the users' accounts inside the suspended Container.
- You cannot repair the suspended Container.

Running Commands in Container

Usually, a Container administrator logs in to the Container via network and executes any commands in the Container as on any other Linux box. However, you might need to execute commands inside Containers bypassing the normal login sequence. This can happen if:

- You do not know the Container login information, and you need to run some diagnosis commands inside the Container in order to verify that it is operational.
- Network access is absent for a Container. For example, the Container administrator might have accidentally applied incorrect firewalling rules or stopped the SSH daemon.

The Virtuozzo Containers software allows you to execute commands in a Container in these cases. Use the `vzctl exec <CT_ID>` command for running a command inside the Container with the given ID. The session below illustrates the situation when the SSH daemon is not started:

```
# vzctl exec 101 /etc/init.d/sshd status
sshd is stopped
# vzctl exec 101 /etc/init.d/sshd start
Starting sshd:[  OK  ]
# vzctl exec 101 /etc/init.d/sshd status
sshd (pid 26187) is running...
```

Now Container users can log in to the Container via SSH.

When executing commands inside a Container from shell scripts, use the `vzctl exec2` command. It has the same syntax as `vzctl exec` but returns the exit code of the command being executed instead of the exit code of `vzctl` itself. You can check the exit code to find out whether the command has completed successfully.

If you wish to execute a command in all running Containers, you can use the following script:

```
# for i in `cat /proc/vz/veinfo | awk '{print $1}'|egrep -v '^0$'`; \
do echo "Container $i"; vzctl exec $i <command>; done
```

where `<command>` is the command to be executed in all the running Containers. For example:

```
# for i in `cat /proc/vz/veinfo | awk '{print $1}'|egrep -v '^0$'`; \
do echo "Container $i"; vzctl exec $i uptime; done
Container 1
  2:26pm  up 6 days,  1:28,  0 users,  load average: 0.00, 0.00, 0.00
Container 101
  2:26pm  up 6 days,  1:39,  0 users,  load average: 0.00, 0.00, 0.00
[The rest of the output is skipped...]
```

C H A P T E R 4

Managing Resources

The main goal of resource control in Virtuozzo Containers 4.0 is to provide Service Level Management or Quality of Service for Containers. Correctly configured resource control settings prevent serious impacts resulting from the resource over-usage (accidental or malicious) of any Container on the other Containers. Using resource control parameters for resources management also allows to enforce fairness of resource usage among Containers and better service quality for preferred Containers, if necessary.

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What are Resource Control Parameters?

The system administrator controls the resources available to a Container through a set of resource management parameters. All these parameters are defined either in the Virtuozzo global configuration file (`/etc/vz/vz.conf`), or in the respective Container configuration files (`/etc/vz/conf/`*`CT_ID`*), or in both. You can set them by manually editing the corresponding configuration files, by using the Virtuozzo command-line utilities, or through Parallels Management Console. These parameters can be divided into the disk, network, CPU, and system categories. The table below summarizes these groups:

Group	Description	Parameter names	Explained in
Disk	This group of parameters determines disk quota in Parallels Virtuozzo Containers. The Virtuozzo disk quota is realized on two levels: the per-Container level and the per-user/group level. You can turn on/off disk quota on any level and configure its settings.	`DISK_QUOTA`, `DISKSPACE`, `DISKINODES`, `QUOTATIME`, `QUOTAUGIDLIMIT`, `IOPRIO`	Managing Disk Quotas

Network	This group of parameters determines Container the management of network bandwidth available to different Containers (network shaping). You can turn on/off network shaping and configure the settings for different Containers.	TRAFFIC_SHAPING, BANDWIDTH, TOTALRATE, RATE, RATEBOUND	Managing Network Accounting and Bandwidth
CPU	This group of parameters defines the CPU time different Containers are guaranteed to receive.	VE0CPUUNITS, CPUUNITS, CPUS, BURST_CPULIMIT, BURST_CPU_AVERAGE_USAGE	Managing Container CPU Resources
System	This group of parameters allows you to easily and effectively configure and control all memory-related parameters inside Containers.	slmmemorylimit	Managing System Parameters

Managing Disk Quotas

This section explains what disk quotas are, defines disk quota parameters, and describes how to perform disk quota related operations:

- Turning on and off per-Container (first-level) disk quotas;
- Setting up first-level disk quota parameters for a Container;
- Turning on and off per-user and per-group (second-level) disk quotas inside a Container;
- Setting up second-level quotas for a user or for a group;
- Checking disk quota statistics;
- Cleaning up Containers in certain cases.

What are Disk Quotas?

Disk quotas enable system administrators to control the size of Linux file systems by limiting the amount of disk space and the number of inodes a Container can use. These quotas are known as per-Container quotas or first-level quotas in Parallels Virtuozzo Containers. In addition, the Virtuozzo Containers software enables the Container administrator to limit disk space and the number of inodes that individual users and groups in that Container can use. These quotas are called per-user and per-group quotas or second-level quotas in Parallels Virtuozzo Containers.

By default, first-level quotas on your Node are enabled (which is defined in the Virtuozzo global configuration file), whereas second-level quotas must be turned on for each Container separately (in the corresponding Container configuration files). It is impossible to turn on second-level disk quotas for a Container if first-level disk quotas are off for that Container.

The Virtuozzo Containers software keeps quota usage statistics and limits in `/var/vzquota/quota.<CT_ID>` - a special quota file. The quota file has a special flag indicating whether the file is "dirty". The file becomes dirty when its contents become inconsistent with the real Container usage. This means that when the disk space or inodes usage changes during the Container operation, these statistics are not automatically synchronized with the quota file, the file just gets the "dirty" flag. They are synchronized only when the Container is stopped or when the Hardware Node is shut down. After synchronization, the "dirty" flag is removed. If the Hardware Node has been incorrectly brought down (for example, the power switch was hit), the file remains "dirty", and the quota is re-initialized on the next Container startup. This operation may noticeably increase the Node startup time. Thus, it is highly recommended to shut down the Hardware Node properly.

Disk Quota Parameters

The table below summarizes the disk quota parameters that you can control. The **File** column indicates whether the parameter is defined in the Virtuozzo global configuration file (G), in the Container configuration files (V), or it is defined in the global configuration file but can be overridden in a separate Container configuration file (GV).

Parameter	Description	File
`disk_quota`	Indicates whether first-level quotas are on or off for all Containers or for a separate Container.	GV
`diskspace`	Total size of disk space the Container may consume, in 1-Kb blocks.	V
`diskinodes`	Total number of disk inodes (files, directories, and symbolic links) the Container can allocate.	V
`quotatime`	The grace period for the disk quota overusage defined in seconds. The Container is allowed to temporarily exceed its quota soft limits for no more than the `QUOTATIME` period.	V
`quotaugidlimit`	This parameter defines the maximum aggregate number of user IDs and group IDs for which disk quota inside the given Container will be accounted. If set to 0, the UID and GID quota will be disabled.	V
`ioprio`	The Container priority for disk I/O operations. The greater the priority, the more time the Container has for writing to and reading from the disk.	V

Turning On and Off Per-Container Disk Quotas

The parameter that defines whether to use first-level disk quotas is `DISK_QUOTA` in the Virtuozzo global configuration file (`/etc/vz/vz.conf`). By setting it to "no", you will disable Virtuozzo quotas completely.

This parameter can be specified in the Container configuration file (`/etc/vz/conf/<CT_ID>.conf`) as well. In this case its value will take precedence of the one specified in the global configuration file. If you intend to have a mixture of Containers with quotas turned on and off, it is recommended to set the `DISK_QUOTA` value to "yes" in the global configuration file and to "no" in the configuration file of that Container which does not need quotas.

The session below illustrates a scenario when first-level quotas are on by default and are turned off for Container 101:

```
[checking that quota is on]
# grep DISK_QUOTA /etc/vz/vz.conf
DISK_QUOTA=yes

[checking available space on /vz partition]
# df /vz
Filesystem           1k-blocks      Used Available Use% Mounted on
/dev/sda2              8957295   1421982   7023242  17% /vz

[editing Container configuration file to add DISK_QUOTA=no]
# vi /etc/vz/conf/101.conf

[checking that quota is off for Container 101]
# grep DISK_QUOTA /etc/vz/conf/101.conf
DISK_QUOTA=no

# vzctl start 101
Starting Container ...
Container is mounted
Adding IP address(es): 10.0.16.101
Hostname for Container set: ve101
Container start in progress...
# vzctl exec 101 df
Filesystem           1k-blocks      Used Available Use% Mounted on
vzfs                   8282373    747060   7023242  10% /
```

As the above example shows, the only disk space limit a Container with the quotas turned off has is the available space and inodes on the partition where the Container private area resides.

To view and/or change the `DISK_QUOTA` parameter status in the Virtuozzo global file using Parallels Management Console, do the following:

1 In the Management Console left pane, right-click the needed Node and select **Tasks --> Manage Virtuozzo Configuration** on the context menu.

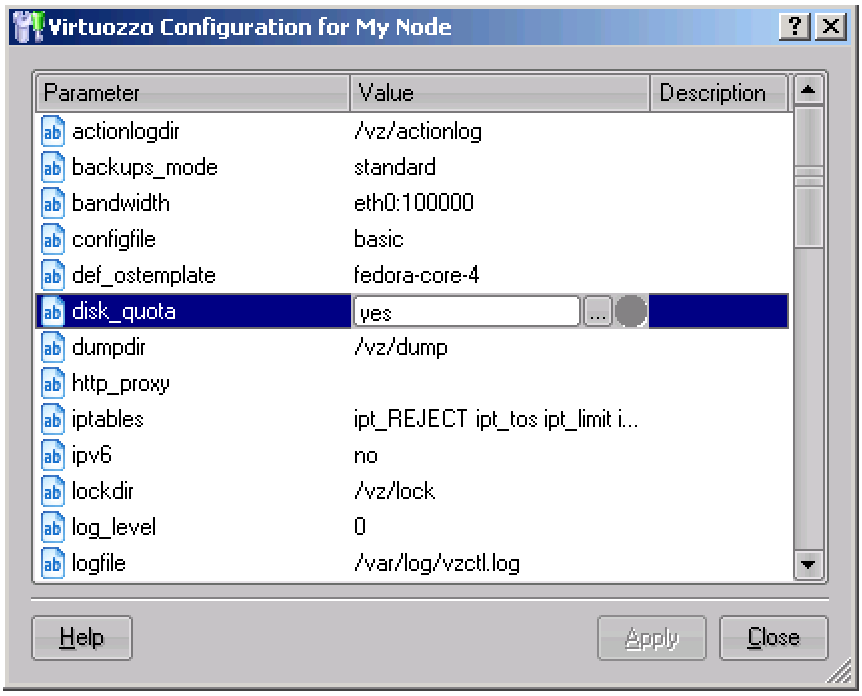

Figure 42: Management Console - Enabling Per-Container Disk Quota

2 In the displayed window, you can view the current status of the `disk_quota` parameter and modify it, if necessary.

3 Click the **Apply** button.

Parallels Management Console does not let you enable/disable disk quotas for separate Containers, thus overriding the global setting. If the first-level quotas are on by default, there is no way to rescind the calculation of quota data for a Container by means of Management Console. However, you can allow this Container to have an almost unlimited disk space and the number of inodes by doing the following:

1 Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.

2 Click the **Resources** tab and select the **Disk Quota** item:

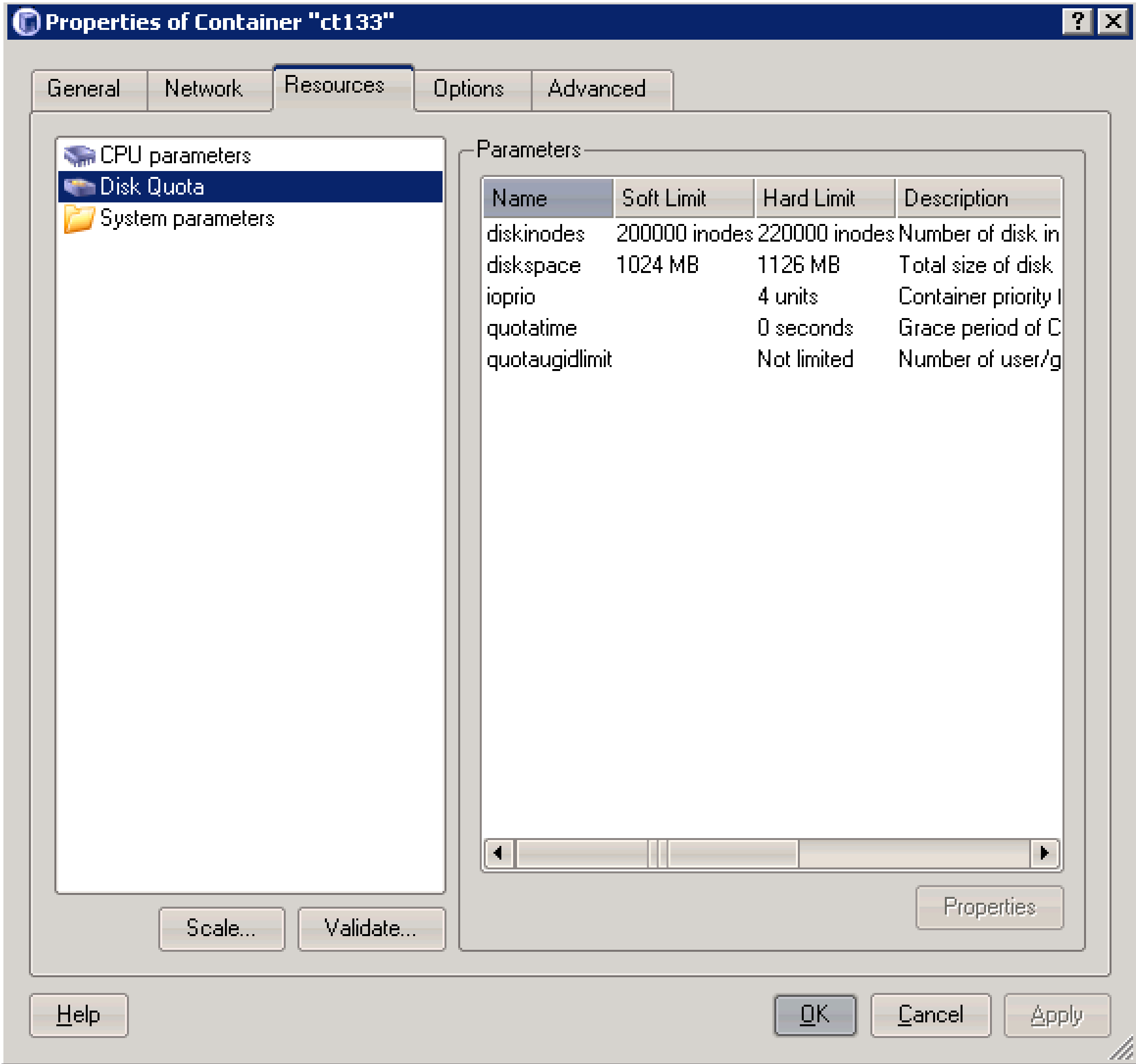

Figure 43: Management Console - Container Disk Quota Parameters

3 Double-click the `diskinodes` parameter, and select the Not limited check box to remove any limits on the number of disk inodes for the given Container.

4 Click OK twice.

5 If necessary, repeat Steps 3 and 4 for the `diskspace` parameter to allow the given Container to have unlimited disk space.

Note: You must change the `DISK_QUOTA` parameter in the global Virtuozzo configuration file only when all Containers are stopped, and in the Container configuration file – only when the corresponding Container is stopped. Otherwise, the configuration may prove inconsistent with the real quota usage, and this can interfere with the normal Hardware Node operation.

Setting Up Per-Container Disk Quota Parameters

Three parameters determine how much disk space and inodes a Container can use. These parameters are specified in the Container configuration file:

`DISKSPACE`	The total size of disk space that can be consumed by the Container in 1-Kb blocks. When the space used by the Container hits the soft limit, the Container can allocate additional disk space up to the hard limit during the grace period specified by the `QUOTATIME` parameter.
`DISKINODES`	The total number of disk inodes (files, directories, and symbolic links) the Container can allocate. When the number of inodes used by the Container hits the soft limit, the Container can create additional file entries up to the hard limit during the grace period specified by the `QUOTATIME` parameter.
`QUOTATIME`	The grace period of the disk quota specified in seconds. The Container is allowed to temporarily exceed the soft limit values for the disk space and disk inodes quotas for no more than the period specified by this parameter.

The first two parameters have both soft and hard limits (or, simply, barriers and limits). The hard limit is the limit that cannot be exceeded under any circumstances. The soft limit can be exceeded up to the hard limit, but as soon as the grace period expires, the additional disk space or inodes allocations will fail. Barriers and limits are separated by colons (":") in Container configuration files and in the command line.

The following session sets the disk space available to Container 101 to approximately 1Gb and allows the Container to allocate up to 90,000 inodes. The grace period for the quotas is set to ten minutes:

```
# vzctl set 101 --diskspace 1000000:1100000 --save
Saved parameters for Container 101
# vzctl set 101 --diskinodes 90000:91000 --save
Saved parameters for Container 101
# vzctl set 101 --quotatime 600 --save
Saved parameters for Container 101
# vzctl exec 101 df
Filesystem           1k-blocks      Used Available Use% Mounted on
vzfs                   1000000    747066    252934  75% /
# vzctl exec 101 stat -f /
  File: "/"
    ID: 0        0        Namelen: 255     Type: UNKNOWN (0x565a4653)
Blocks: Total: 1000000  Free: 252934   Available: 252934   Size: 1024
Inodes: Total: 90000      Free: 9594
```

It is possible to change the first-level disk quota parameters for a running Container. The changes will take effect immediately. If you do not want your changes to persist till the next Container startup, do not use the `--save` switch.

To set up per-Container disk quota parameters using Parallels Management Console, do the following:

1 Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.
2 Click the **Resources** tab and select **Disk Quota**.
3 Double-click the `diskinodes` parameter in the right part of the displayed window, and enter the soft limit and hard limit values for this parameter in the fields provided. For example:

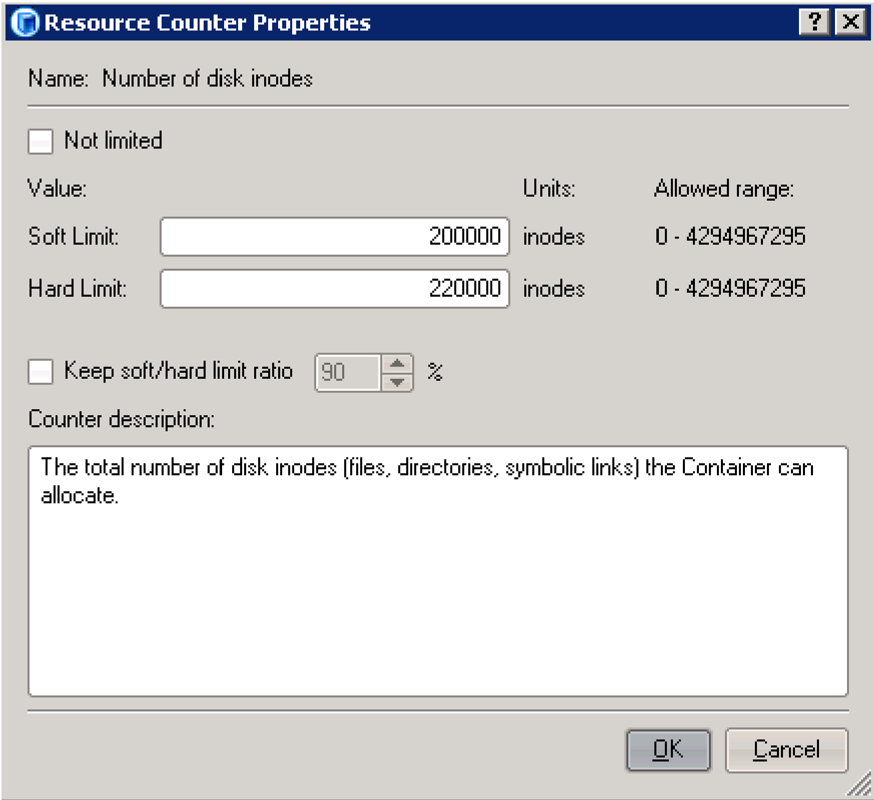

Figure 44: Management Console - Setting Up Container Disk Quota

The hard limit is the limit that cannot be exceeded under any circumstances. The soft limit can be exceeded up to the hard limit, but as soon as the grace period expires, the additional disk space or inodes allocations will fail.

4 Click **OK**.

5 If necessary, repeat Steps 3 and 4 for the `diskspace` and `quotatime` parameters to define the disk space quota and its grace period for the given Container.

Turning On and Off Second-Level Quotas for Container

The parameter that controls the second-level disk quotas is `QUOTAUGIDLIMIT` in the Container configuration file. By default, the value of this parameter is zero and this corresponds to disabled per-user and per-group quotas.

If you assign a non-zero value to the `QUOTAUGIDLIMIT` parameter, this action brings about the two following results:

1 Second-level (per-user and per-group) disk quotas are enabled for the given Container;

2 The value that you assign to this parameter will be the limit for the number of file owners and groups of this Container, including Linux system users. Note that you will theoretically be able to create extra users of this Container, but if the number of file owners inside the Container has already reached the limit, these users will not be able to own files.

Enabling per-user and per-group quotas for a Container requires restarting the Container. The value for it should be carefully chosen; the bigger value you set, the bigger kernel memory overhead this Container creates. This value must be greater than or equal to the number of entries in the Container `/etc/passwd` and `/etc/group` files. Taking into account that a newly created Red Hat Linux-based Container has about 80 entries in total, the typical value would be 100. However, for Containers with a large number of users this value may be increased.

When managing the quotaugidlimit parameter, please keep in mind the following:

- if you delete a registered user but some files with their ID continue residing inside your Container, the current number of ugids (user and group identities) inside the Container will not decrease.
- if you copy an archive containing files with user and group IDs not registered inside your Container, the number of ugids inside the Container will increase by the number of these new IDs.

The session below turns on second-level quotas for Container 101:

```
# vzctl set 101 --quotaugidlimit 100 --save
Unable to apply new quota values: ugid quota not initialized
Saved parameters for Container 101
# vzctl stop 101; vzctl start 101
Stopping Container ...
Container was stopped
Container is unmounted
Starting Container ...
Container is mounted
Adding IP address(es): 192.168.1.101
Hostname for Container set: ct101
Container start in progress...
```

In Parallels Management Console, Virtuozzo second-level disk quotas are controlled in the window that you may access by performing the following actions:

1 Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.

2 Click the **Resources** tab and the **Disk Quota** item.

3 Double-click the `quotaugidlimit` parameter:

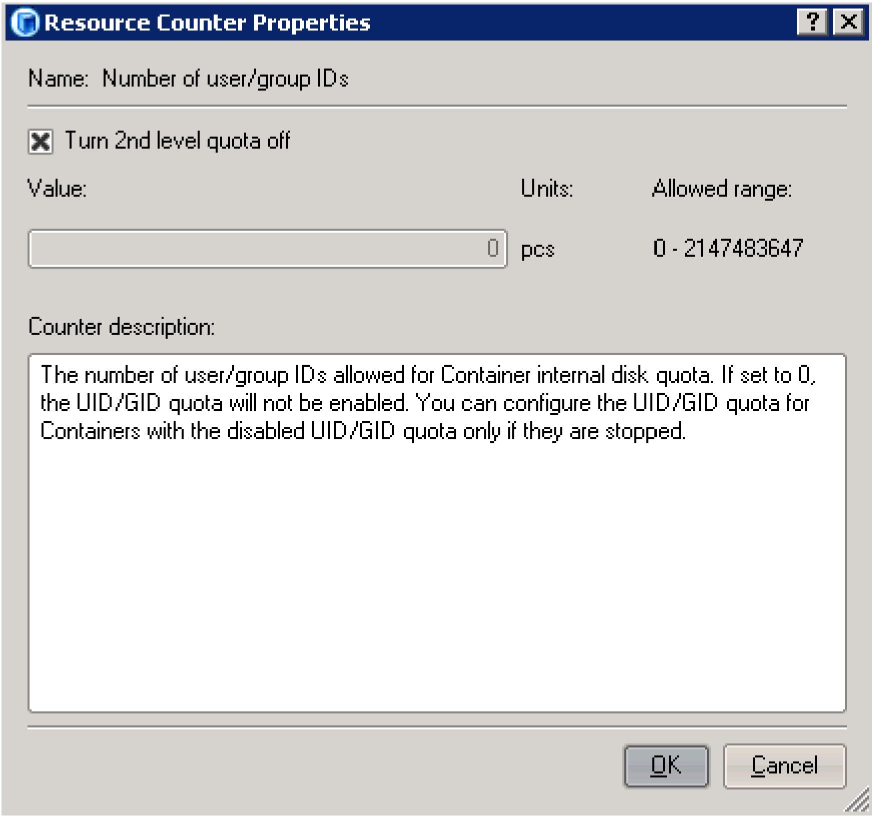

Figure 45: Management Console - Turning Second-Level Disk Quota On and Off

4 Clear the Turn 2nd level quota off check box, enter the desired value in the Value field, and click OK.

5 Restart the Container, if it running, for the changes to take effect.

Setting Up Second-Level Disk Quota Parameters

The Virtuozzo Containers software provides the standard Linux `quota` package for working inside Containers:

```
# vzctl exec 101 rpm -q quota
quota-4.03-1.1.parallels
```

This command shows that the `quota` package installed in the Container is built and shipped by Parallels. Use the utilities from this package (as is prescribed in your Linux manual) to set Virtuozzo second-level quotas for the given Container. For example:

```
# ssh ct101
root@ct101's password:
Last login: Sat Jul 5 00:37:07 2007 from 10.100.40.18
[root@ct101 root]# edquota root
Disk quotas for user root (uid 0):
  Filesystem   blocks      soft      hard     inodes     soft    hard
  /dev/vzfs    38216       50000     60000    45454      70000   70000
[root@ct101 root]# repquota -a
*** Report for user quotas on device /dev/vzfs
Block grace time: 00:00; Inode grace time: 00:00
                        Block limits                File limits
User            used    soft    hard  grace    used  soft  hard  grace
----------------------------------------------------------------------
root      --   38218   50000   60000          45453 70000 70000
[the rest of repquota output is skipped]

[root@ct101 root]# dd if=/dev/zero of=test
dd: writing to `test': Disk quota exceeded
23473+0 records in
23472+0 records out
[root@ct101 root]# repquota -a
*** Report for user quotas on device /dev/vzfs
Block grace time: 00:00; Inode grace time: 00:00
                        Block limits                File limits
User            used    soft    hard  grace    used  soft  hard  grace
----------------------------------------------------------------------
root      +-   50001   50000   60000   none   45454 70000 70000
[the rest of repquota output is skipped]
```

The above example shows the session when the `root` user has the disk space quota set to the hard limit of 60,000 1Kb blocks and to the soft limit of 50,000 1Kb blocks; both hard and soft limits for the number of inodes are set to 70,000.

It is also possible to set the grace period separately for block limits and inodes limits with the help of the `/usr/sbin/setquota` command. For more information on using the utilities from the `quota` package, please consult the system administration guide shipped with your Linux distribution or online manual pages included in the package.

Parallels Management Console also provides means for setting up second-level disk quotas in Virtuozzo Containers 4.0. You should perform the following steps:

1. Open the needed Container manager window by double-clicking the corresponding Container line in the right pane of the Parallels Management Console window.
2. Select the **Users and Groups** item in the left pane of the Container manager window.
3. In the right pane, select either the **Groups** or **Users** tab to see the list of Container registered groups or users, respectively.

4 Double-click the name of the group/user for whom you want to set up the quota parameters. The group/user Properties window appears.

5 Click the Disk Quota tab in this window:

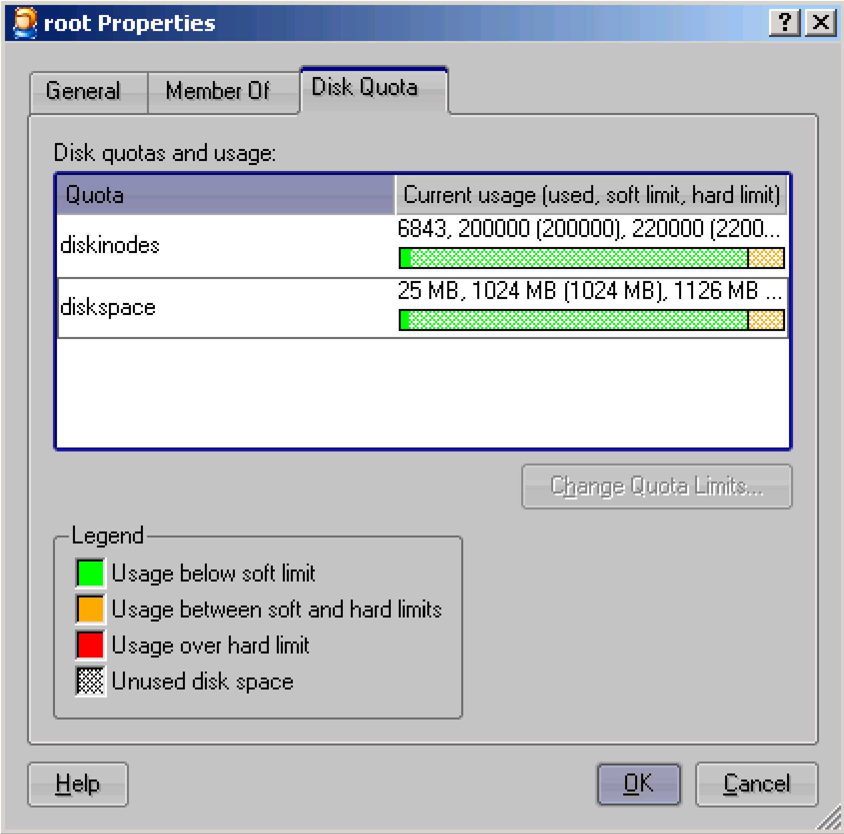

Figure 46: Management Console - Setting Up Second-Level Disk Quota Parameters

6 Select the needed quota parameter (either `diskinodes` or `diskspace`) and click the Change Quota Limits button.

7 In the displayed window, enter the quota settings of your choice for the current group/user.

8 Click OK to close the Second Level Disk Quota window; then click OK to close the group/user Properties window.

Checking Quota Status

As the Hardware Node administrator, you can check the quota status for any Container with the `vzquota stat` and `vzquota show` commands. The first command reports the status from the kernel and shall be used for running Containers. The second command reports the status from the quota file (located at `/var/vzquota/quota.<CT_ID>`) and shall be used for stopped Containers. Both commands have the same output format.

The session below shows a partial output of Container 101 quota statistics:

```
# vzquota stat 101 –t
   resource          usage       softlimit      hardlimit    grace
  1k-blocks          38281         1000000        1100000
     inodes          45703           90000          91000
User/group quota: on,active
Ugids: loaded 34, total 34, limit 100
Ugid limit was exceeded: no

User/group grace times and quotafile flags:
 type block_exp_time inode_exp_time  dqi_flags
 user                                       0h
group                                       0h

User/group objects:
ID    type   resource    usage   softlimit   hardlimit    grace status
0     user  1k-blocks    38220       50000       60000          loaded
0     user     inodes    45453       70000       70000          loaded
[the rest is skipped]
```

The first three lines of the output show the status of first-level disk quotas for the Container. The rest of the output displays statistics for user/group quotas and has separate lines for each user and group ID existing in the system.

If you do not need the second-level quota statistics, you can omit the `–t` switch from the `vzquota` command line.

To check the first-level quota status for a Container in Parallels Management Console, you should:

1. Open the needed Container manager window by double-clicking on the corresponding Container line in the right pane of the Management Console window;
2. Expand the **Monitor** item and select the **Quotas and Usage** folder.

You can see the first-level quota statistics for the current Container in the right pane of the window:

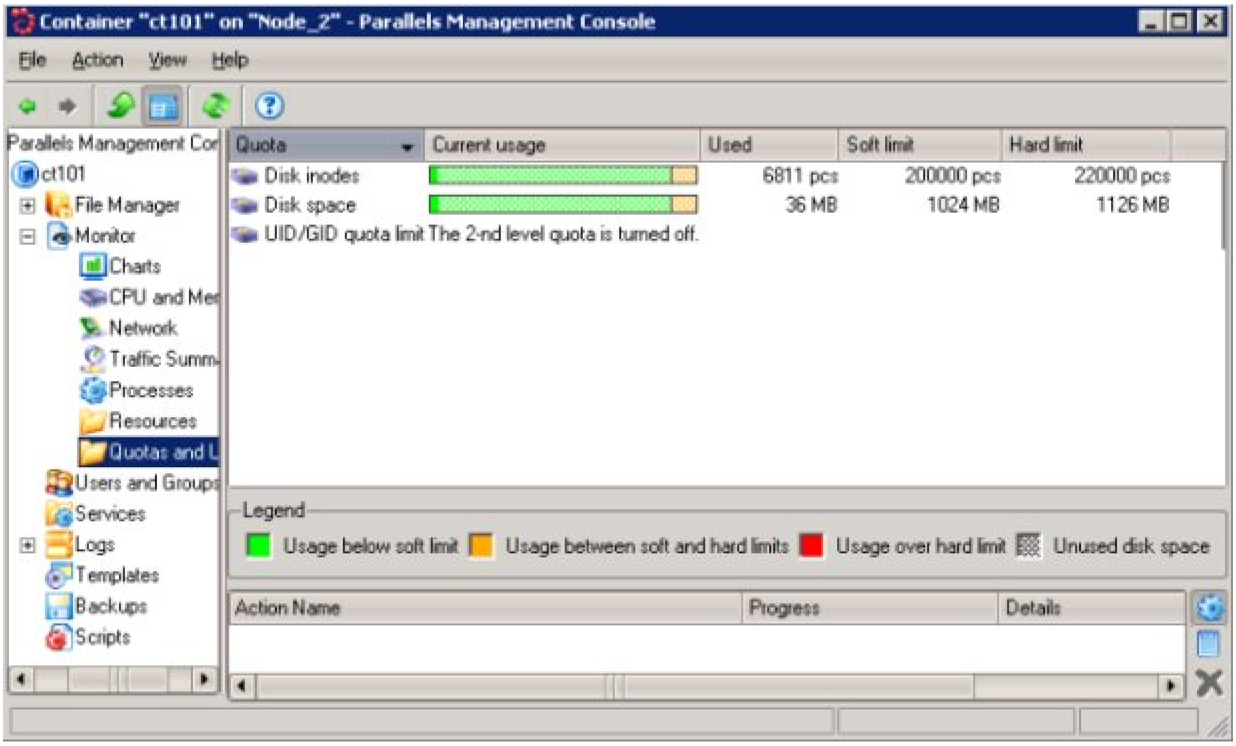

Figure 47: Management Console - Viewing Container Quota Statistics

To check the second-level disk quota parameters for any group or user of the given Container, perform Steps 1 thru 5 as is indicated in the previous section.

Configuring Container Disk I/O Priority Level

Virtuozzo Containers 4.0 provides you with the capability of configuring the Container disk I/O (input/output) priority level. The higher the Container I/O priority level, the more time the Container will get for its disk I/O activities as compared to the other Containers on the Node. By default, any Container on the Hardware Node has the I/O priority level set to 4. However, you can change the current Container I/O priority level in the range from 0 to 7 using the `--ioprio` option of the `vzctl set` command. For example, you can issue the following command to set the I/O priority of Container 101 to 6:

```
# vzctl set 101 --ioprio 6 --save
Saved parameters for Container 101
```

To check the I/O priority level currently applied to Container 101, you can execute the following command:

```
# grep IOPRIO /etc/vz/conf/101.conf
IOPRIO="6"
```

The command output shows that the current I/O priority level is set to 6.

To configure the I/O priority level of a particular Container in Parallels Management Console, do the following:

1. Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.
2. Click the **Resources** tab and then the **Disk Quota** item.
3. Double-click the `ioprio` parameter:

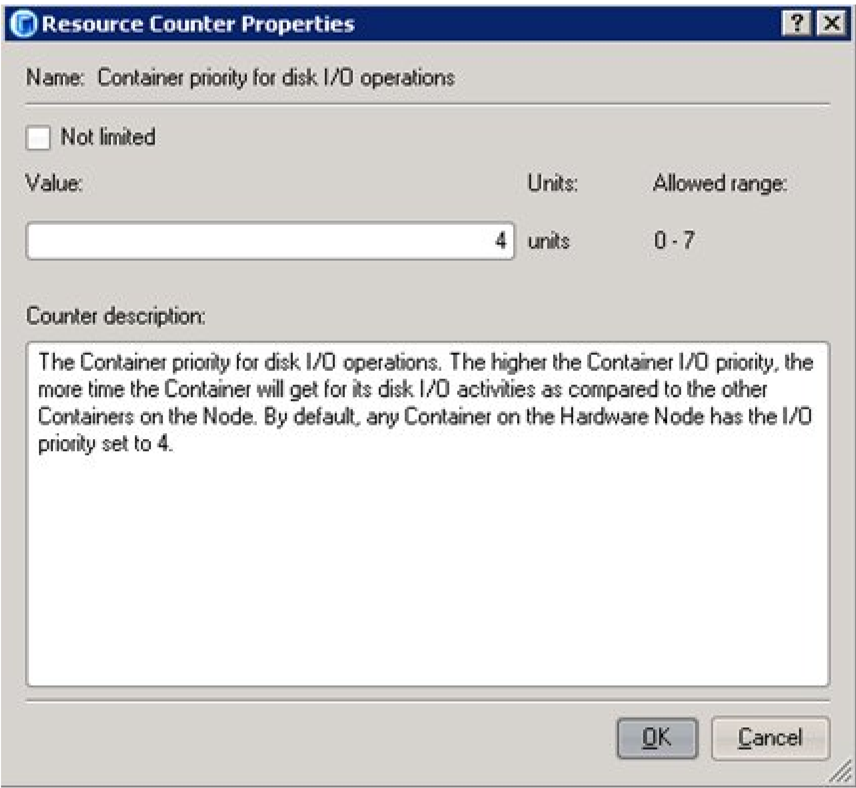

Figure 48: Management Console - Configuring Container Disk I/O Priority Level

4 In the **Resource Counter Properties** window, you can view the disk I/O priority level currently set for the Container and change it, if necessary, by entering the desired value (from 0 to 7) in the field provided and clicking **OK**.

Cleaning Up Containers

The first-level quota assigned to this or that Container essentially shows how much space may be occupied by the Container *private* files, i.e. not by the OS or common applications files. The real OS and application files reside in the `/vz/template` directory on the Hardware Node and practically do not add up to the Container quota (except for the symlinks to them located inside the Container and occupying insignificant space).

However, there are situations when one and the same application or application update is installed not as a template, but separately inside each and every Container. A good example of this is the CPanel application with its robust auto-update features. If a certain version of CPanel is installed in a number of Containers, and then an update is released, CPanel automatically updates itself in all these Containers, thus creating a vast amount of identical files (not symlinks already) throughout the Containers. These files tell dramatically on the Container quotas, which may be avoided by putting all the identical files to the Hardware Node template area and creating symlinks instead of real files inside the affected Containers.

The problem like the one described above can be solved in two ways:

1 A special subarea is created inside the Hardware Node template area - `/vz/template/vc` - for housing the files identical among multiple Containers with the help of the `vzcache` utility.

2 If the application or application update installed directly into one or more Containers has a corresponding application template or template update installed on the Hardware Node, the real files inside the Container(s) are replaced with symlinks to the template files on the Node with the help of the `vzpkglink` and `vzpkg link` utilities. These utilities are used to create symlinks to application standard and EZ templates, respectively.

Moving Container Files to Cache Area on Hardware Node

We will illustrate the effect produced by `vzcache` by copying one and the same huge dummy file into two Containers. First, let us learn the disk space occupied by the whole `/vz` partition and by the two Containers - Container 101 and Container 102:

```
# df /vz
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/hda3             13756796   1348292  11622123  11% /vz
# vzctl exec 101 df
Filesystem           1K-blocks      Used Available Use% Mounted on
vzfs                   1048576     22311   1026265   3% /
# vzctl exec 102 df
Filesystem           1K-blocks      Used Available Use% Mounted on
vzfs                   1048576     22311   1026265   3% /
```

After that, we copy the dummy file, which is around 600 Mb in size, to the root of these Containers:

```
# cp foo /vz/root/101
# cp foo /vz/root/102
```

Now check the disk space once again:

```
# df /vz
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/hda3             13756796   2569060  10401355  20% /vz
# vzctl exec 101 df
Filesystem           1K-blocks      Used Available Use% Mounted on
vzfs                   1048576    632430    416146  61% /
# vzctl exec 102 df
Filesystem           1K-blocks      Used Available Use% Mounted on
vzfs                   1048576    632430    416146  61% /
```

We see that around 600 Mb has been added to the space occupied by each Container and, consequently, around 1.2 Gb has been added to the space used on the `/vz` partition. Now it's time to resort to `vzcache` to get rid of identical files inside the Containers:

```
# vzcache -v 101 102
Processing VZFSv2 Container 101
VZFSv2 Container 101         78 regular files
Processing VZFSv2 Container 102
VZFSv2 Container 102         78 regular files
```

During the command execution, `vzcache`:

- looks for identical files inside Container 101 and Container 102;
- creates the *`CT_UUID`* subdirectory (where *`CT_UUID`* denotes the Container unique identifier and can be determined by viewing the `UUID` parameters in the Container configuration file) within the Hardware Node template area (`/vz/template/vc` by default) for each Container;
- moves the identical files to the created subdirectories in the Hardware Node template area.

Let us now take the final look at the disk space usage:

```
# df /vz
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/hda3             13756796   1953053  11017362  16% /vz
# vzctl exec 101 df
Filesystem           1K-blocks      Used Available Use% Mounted on
vzfs                   1048576     15105   1033471   2% /
# vzctl exec 102 df
Filesystem           1K-blocks      Used Available Use% Mounted on
vzfs                   1048576     15138   1033438   2% /
```

As you can see, both the Hardware Node and the Containers have each gained more than 600 Mb of disk space. In real life, the disk space is gained by caching not one huge file in two Containers but a number of identical files across many Containers.

The operation of the `vzcache` utility may be customized to a certain extent by using `vzcache` command line switches (see the Parallels Virtuozzo Containers Reference Guide for details).

Associating Container Files With Application Templates

It may often happen that a security update should immediately be applied to a package installed as a template on the Node and added to a number of Containers hosted there. However, it takes certain time to prepare a template update, so the Hardware Node and/or Container administrators are not inclined to wait for it and they install the original security update directly inside the Containers. As to the template update, it becomes available a few days afterwards. In other cases, a Container administrator might not know that there is a certain template installed on the Hardware Node, so they install the corresponding application directly inside their Container.

To eliminate cluttering up the Container disk space with application files that are present as part of an application template on the Hardware Node, the `vzpkg link` and `vzpkglink` utilities are used.

- The `vzpkg link` utility is used to link your Container to the application EZ templates installed on the Hardware Node. For example, you can use the following command to replace the `openssl` files inside Container 101 running Fedora 8 with symlinks to these files in the `/vz/template/fedora-core/8/x86/config/app/openssl` directory on the Node:

```
# vzpkg link 101
```

- The `vzpkglink` utility is used to replace real files inside your Containers with symlinks to application standard templates installed on the Hardware Node. The following session illustrates how to perform this operation:
  - First, check if the Container files are compatible with the template version installed on the Node. For example:

```
# vzpkglink -t -vv 101 openssl/20061118
```

  - If this test performs successfully, you can drop the `-t` switch and replace the `openssl` files inside Container 101 with symlinks to these files in the `/vz/template/openssl` directory on the Hardware Node:

```
# vzpkglink -vv 101 openssl/20061118
```

  Issuing the `vzpkgls 101` command now will let you ensure that the `openssl` template has been added to the Container configuration file.

Managing Container CPU Resources

The current section explains the CPU resource parameters that you can configure and monitor for each Container.

The table below provides the name and the description for the CPU parameters. The **File** column indicates whether the parameter is defined in the Virtuozzo global configuration file (G) or in the Container configuration files (V).

Parameter	Description	File
`ve0cpuunits`	This is a positive integer number that determines the minimal guaranteed share of the CPU time Container 0 (the Hardware Node itself) will receive at its startup. It is recommended to set the value of this parameter to be 5-10% of the power of the Hardware Node. After the Node is up and running, you can redefine the amount of the CPU time allocated to the Node by using the `--cpuunits` parameter with the `vzctl set` command.	G
`cpuunits`	This is a positive integer number that determines the minimal guaranteed share of the CPU time the corresponding Container will receive. **Note:** In the current version of Virtuozzo Containers, you can also use this parameter to define the CPU time share for the Hardware Node.	V
`cpulimit`	This is a positive number indicating the CPU time, in percent, the corresponding Container is not allowed to exceed.	V
`burst_cpu_avg_usage`	The CPU usage limit, in percent, used by the Parallels Agent software when controlling the CPU consumption of all Containers currently running on the Hardware Node.	G, V
`burst_cpulimit`	The CPU power limit, in per cent, the Container cannot exceed. The limitations set in this parameter are applied to the Container when it exceeds the limit specified in the `burst_cpu_avg_usage` parameter.	G, V
`cpus`	The number of CPUs to be used to handle the processes running inside the corresponding Container.	V

Managing CPU Share

The Virtuozzo Containers 4.0 CPU resource control utilities allow you to guarantee any Container the amount of CPU time this Container receives. The Container can consume more than the guaranteed value if there are no other Containers competing for the CPU and the `cpulimit` parameter is not defined.

Note: The CPU time shares and limits are calculated on the basis of a one-second period. Thus, for example, if a Container is not allowed to receive more than 50% of the CPU time, it will be able to receive no more than half a second each second.

To get a view of the optimal share to be assigned to a Container, check the current Hardware Node CPU utilization:

```
# vzcpucheck
Current CPU utilization: 11142
Power of the node: 125504
```

The output of this command displays the total number of the so-called CPU units consumed by all running Containers and Hardware Node processes. This number is calculated by Virtuozzo with the help of a special algorithm. The above example illustrates the situation when the Hardware Node is underused. In other words, the running Containers receive more CPU time than was guaranteed to them.

In the following example, Container 102 is guaranteed to receive about 4% of the CPU time even if the Hardware Node is fully used, or in other words, if the current CPU utilization equals the power of the Node. Besides, Container 102 will not receive more than 25% of the CPU time even if the CPU is not fully loaded:

```
# vzctl set 102 --cpuunits 5000 --cpulimit 25 --save
Saved parameters for Container 102
# vzctl start 102
Starting Container ...
Container is mounted
Adding IP address(es): 192.168.1.102
Container start in progress...
# vzcpucheck
Current CPU utilization: 15154
Power of the Node: 125504
```

Container 102 will receive from 4% to 25% of the Hardware Node CPU time unless the Hardware Node is overcommitted, i.e. the running Containers have been promised more CPU units than the power of the Hardware Node. In this case the Container might get less than 4 percent.

Note: To set the `--cpuunits` parameter for the Hardware Node, you should indicate 0 as the Container ID (e.g. `vzctl set 0 --cpuunits 5000 --save`).

To view and/or change the `VE0CPUUNITS` parameter using Parallels Management Console, do the following:

1 Right-click the needed Node and select Tasks --> Manage Virtuozzo Configuration on the context menu.

2 In the displayed window, select the `ve0cpuunits` parameter.

3 Enter the needed value and click OK.

To view and/or change the `CPUUNITS` or `CPULIMIT` parameter for separate Containers, do the following:

1 Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.
2 Click the **Resources** tab and select **CPU parameters**.
3 Double-click the corresponding parameter in the right part of the displayed window, and, if necessary, enter the right value for the given Container.
4 Click **OK** twice.

Configuring Number of CPUs Inside Container

If your Hardware Node has more than one physical processor installed, you can control the number of CPUs which will be used to handle the processes running inside separate Containers. By default, a Container is allowed to consume the CPU time of all processors on the Hardware Node, i.e. any process inside any Container can be executed on any processor on the Node. However, you can modify the number of physical CPUs which will be simultaneously available to a Container using the `--cpus` option of the `vzctl set` command. For example, if your Hardware Node has 4 physical processors installed, i.e. any Container on the Node can make use of these 4 processors, you can set the processes inside Container 101 to be run on 2 CPUs only by issuing the following command:

```
# vzctl set 101 --cpus 2 --save
```

Note: The number of CPUs to be set for a Container must not exceed the number of physical CPUs installed on the Hardware Node. In this case the 'physical CPUs' notation designates the number of CPUs the Virtuozzo kernel is aware of (you can view this CPU number using the `/proc/cpuinfo` command).

You can check if the number of CPUs has been successfully changed by running the `cat /proc/cpuinfo` command inside your Container. Assuming that you have set two physical processors to handle the processes inside Container 101, your command output may look as follows:

```
# vzctl exec 101 cat /proc/cpuinfo
processor       : 0
vendor_id       : GenuineIntel
cpu family      : 15
model           : 4
model name      : Intel(R) Xeon(TM) CPU 2.80GHz
stepping        : 1
cpu MHz         : 2793.581
cache size      : 1024 KB
...

processor       : 1
vendor_id       : GenuineIntel
cpu family      : 15
model           : 4
model name      : Intel(R) Xeon(TM) CPU 2.80GHz
stepping        : 1
cpu MHz         : 2793.581
cache size      : 1024 KB
...
```

The output shows that Container 101 is currently bound to only two processors on the Hardware Node instead of 4 available for the other Containers on this Node. It means that, from this point on, the processes of Container 101 will be simultaneously executed on no more than 2 physical CPUs while the other Containers on the Node will continue consuming the CPU time of all 4 Hardware Node processors, if needed. Please note also that the physical CPUs proper of Container 101 might not remain the same during the Container operation; they might change for load balancing reasons, the only thing that cannot be changed is their maximal number.

In Parallels Management Console you can configure the number of CPUs to be available to a Container by doing the following:

1 Select the Virtuozzo Containers item under the corresponding Hardware Node name.

2 Right-click the Container for which you wish to change the number of available CPUs and select **Properties** on the context menu.

3 In the **Parameters** table on the **Resources** tab of the displayed window, double-click the `cpus` item:

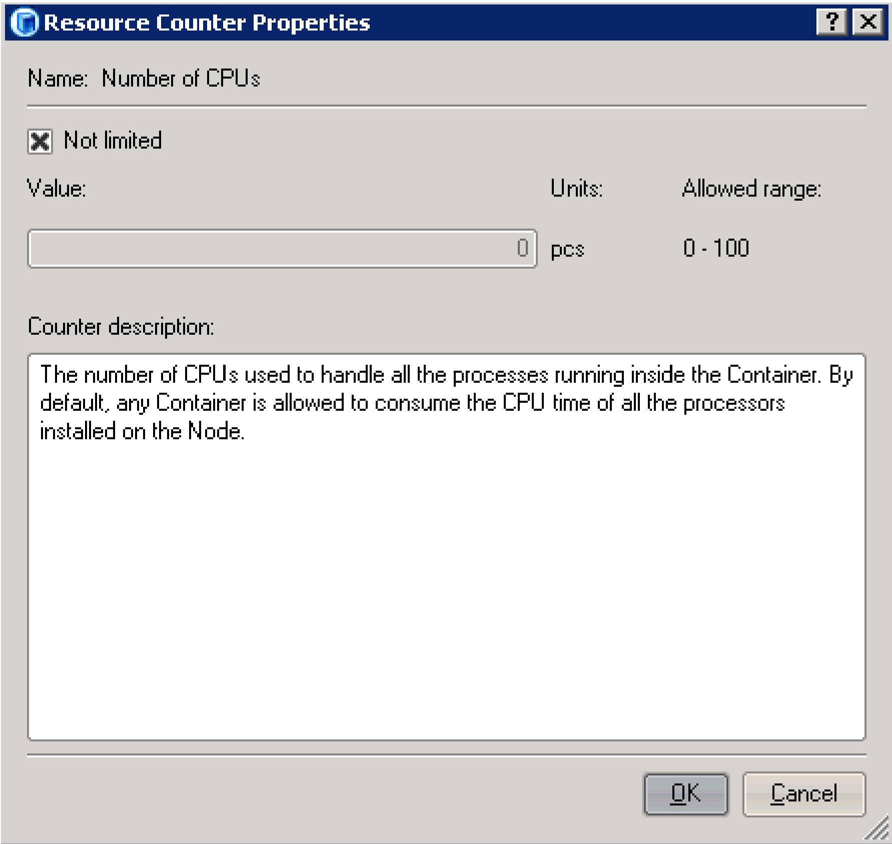

Figure 49: Management Console - Configuring Number of CPUs Inside Container

4 Clear the **Not limited** check box and specify the desired number of CPUs in the **Value** field.

5 Click **OK** twice.

Controlling Container CPU Usage With VZASysD Plug-in

The Virtuozzo Containers software provides you with a special plug-in - VZASysD - allowing to automatically control the CPU consumption of any Container on the Hardware Node. This plug-in is automatically installed on your Node during the Virtuozzo Containers 4.0 installation and gets started once the installation has successfully completed. When launched, the plug-in runs in the background of your system, collects the information on the Container CPU usage limits, compares the gathered information with the current CPU consumption by the corresponding Containers, and limits the Container CPU usage, if necessary.

Note: VZASysD is an integral part of the Parallels Agent software and cannot be monitored or configured using the Virtuozzo Containers software or standard Linux tools.

By default, the VZASysD functionality is disabled for all Containers on the Hardware Node. To enable VZASysD to keep a check on the CPU consumption of a particular Container, you should open the /etc/vz/conf/*CT_ID*.conf file for editing (e.g. using vi) and set the following parameters in this file:

1 BURST_CPU_AVG_USAGE: the CPU usage limit, in percent, set for the Container. This limit is calculated as the ratio of the current Container CPU usage to the CPU limit (i.e to the value of the CPULIMIT parameter) set for the Container in its configuration file. If the limit is not specified, the full CPU power of the Hardware Node is considered as the CPU limit. Upon exceeding the BURST_CPU_AVG_USAGE limit, the VZASysD plug-in sets the Container CPU usage to the value defined in the BURST_CPULIMIT parameter for the given Container (see below).

2 BURST_CPULIMIT: the CPU power limit, in percent, the Container cannot exceed. The plug-in imposes the limitations from this parameter on a Container when this Container exceeds the limit set in the BURST_CPU_AVG_USAGE parameter.

Note: You can also set the BURST_CPU_AVG_USAGE and BURST_CPULIMIT parameters in the Virtuozzo global file (/etc/vz/vz.conf); in this case the specified limits will apply to all Containers on the Hardware Node (if not redefined in the corresponding Container configuration file).

After setting the aforementioned parameters in the Container configuration file, the VZASysD plug-in will carry out one of the following operations depending on the obtained results for the given Container:

- If the CPU usage consumption does not exceed the CPU limit set for the Container in the BURST_CPU_AVG_USAGE parameter, no actions are taken on the VZASysD part.
- If the processor time is currently overused by the Container, VZASysD places the restrictions set in the BURST_CPULIMIT parameter on the Container CPU usage. On the next check:
  - the set limit is removed if the CPU usage does not exceed the value calculated by the following formula: (BURST_CPU_AVG_USAGE x BURST_CPULIMIT) / 100% (the value of the BURST_CPU_AVG_USAGE parameter multiplied by the value of the BURST_CPULIMIT parameter and divided by 100%);
  - the set limit is left intact if the Container CPU usage exceeds the aforementioned value.

For example, you can make the VZASysD plug-in control the CPU usage of Container 101 by editing the BURST_CPU_AVG_USAGE and BURST_CPULIMIT parameters in its configuration file as follows:

```
...
BURST_CPU_AVG_USAGE="80"
BURST_CPULIMIT="60"
...
```

From this moment on, VZASysD will regularly check Container 101 and compare its CPU usage with the value set in the BURST_CPU_AVG_USAGE parameter. If the CPU consumption by Container 101 exceeds the value set in BURST_CPU_AVG_USAGE (i.e. 80%), the plug-in will keep the Container CPU usage under the limit specified in BURST_CPULIMIT (i.e. under 60%). If during the next CPU usage check the CPU consumption by this Container:

- becomes lower than the value calculated using the (BURST_CPU_AVG_USAGE x BURST_CPULIMIT) / 100% formula (i.e. (80% x 60%) / 100% = 48% of the CPU time), the BURST_CPULIMIT limit will be removed;
- still exceeds 48% of the CPU time, the plug-in will continue keeping the Container CPU usage under the value specified in BURST_CPULIMIT.

In Parallels Management Console you can perform the following operations to configure the BURST_CPU_AVG_USAGE and BURST_CPULIMIT parameters for a:

1 Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.
2 Click the **Resources** tab and select **CPU parameters**.
3 Double-click the corresponding parameter (either burst_cpu_avg_usage or burst_cpulimit) in the right part of the displayed window, and, if necessary, enter the right value.
4 Click **OK** twice.

By default, VZASysD checks the Container CPU usage every 5 minutes; however, you can configure the check interval by editing the cpu_check_period parameter in the Parallels Agent configuration file (/var/vzagent/etc/vzagent.conf). For example, you can do it as follows:

1 Right-click the Hardware Node name in the Management Console left pane and select **Tasks --> Manage Parallels Agent Configuration** on the context menu.
2 In the **Parallels Agent Configuration** window, expand the vzasysd key and select the configuration subkey.
3 Double-click the cpu_check_period parameter in the right pane.
4 In the **Edit Parameter** window, enter the value you want in the **Parameter value** field.
5 Click the **OK** button and then the **Apply** button.

Managing Network Accounting and Bandwidth

This section explains how to perform the following tasks:

- Setting up network classes;
- Viewing network traffic statistics;
- Turning on and off network bandwidth management;
- Setting up the bandwidth limit for a Container.

Network Traffic Parameters

The table below summarizes the network traffic parameters that you can control. The File column indicates whether the parameter is defined in the Virtuozzo global configuration file (G), in the Container configuration files (V), or it is defined in the global configuration file but can be overridden in a separate Container configuration file (GV).

Parameter	Description	File
`traffic_shaping`	If set to "yes", traffic limitations for outgoing traffic are set for Containers. The default is "no".	G
`bandwidth`	This parameter lists all the network adapters installed on the Hardware Node and their bandwidth.	G
`totalrate`	This parameter defines the bandwidth to be allocated for each and every network class. It is active if traffic shaping is turned on.	G
`rate`	If traffic shaping is turned on, this parameter specifies the bandwidth guarantee for any Container.	GV
`ratebound`	If this parameter is set to "yes", the bandwidth guarantee (the global rate parameter) is also the limit for the Container, and the Container cannot borrow the bandwidth from the `TOTALRATE` bandwidth pool.	V

Note: In old configuration files, there may remain the `traffic_accounting` parameter in the global configuration file. It is outdated in the current Virtuozzo Containers version, as traffic accounting is always enabled now.

Configuring Network Classes

The Virtuozzo Containers software allows you to track the inbound and outbound network traffic as well as to shape the outgoing traffic for a Container. In order to provide the ability to distinguish between domestic and international traffic, a concept of network classes is introduced. It is important to fully understand this notion, because network classes IDs are used in the values of some network traffic parameters. A network class is a range of IP addresses for which Parallels Virtuozzo counts and shapes the traffic.

Classes are specified in the `/etc/vz/conf/networks_classes` file. The file is in the ASCII format, and all empty lines and lines starting with the '#' sign are ignored. Other lines have the following format:

```
<class_id> <ip_address>/<prefix_length>
```

where `<class_id>` defines the network class ID, and the `<ip_address>/<prefix_length>` pair defines the range of IP addresses for this class. There may be several lines for each class.

Classes 0 and 1 have special meanings. Class 0 defines the IP address range for which no accounting is performed. Usually, it corresponds to the Hardware Node subnet (the Node itself and its Containers). Setting up Class 0 is not required; however, its correct setup improves performance.

Class 1 is defined by Parallels Virtuozzo Containers to match any IP address. It must be always present in the network classes definition file. Therefore, it is suggested not to change the default line

```
1 0.0.0.0/0
```

in the `networks_classes` file. Other Classes should be defined after Class 1. They represent exceptions from the "matching-everything" rule of Class 1. The example below illustrates a possible configuration of the network classes definition file:

```
# Hardware Node Containers networks
0 192.168.0.0/16

# any IP (all traffic)
1 0.0.0.0/0

# class 2 – addresses for the "foreign" traffic
2 10.0.0.0/8
2 11.0.0.0/8

# inside "foreign" network there
# is a hole belonging to "local" traffic
1 10.10.16.0/24
```

In this example the IP addresses in the range of 192.168.0.0 to 192.168.255.255 are treated as Class 0 addresses and no accounting is done for the traffic from Containers destined to these addresses.

Class 2 matches addresses in two ranges: from 10.0.0.0 to 10.255.255.255 and from 11.0.0.0 to 11.255.255.255 with the exception of addresses in the sub-range of 10.10.16.0 to 10.10.16.255, which are treated as Class 1. All other IP addresses belong to Class 1. As far as the Class 2 addresses in this example are used for foreign routing, the Class 1 addresses are used for local (domestic) routing, by the exclusion method.

To set up network classes by means of Parallels Management Console, you should:

1 Right-click the needed Node and select Network Configuration --> Configure Traffic Accounting and Shaping on the context menu.

2 On the Accounting tab of the displayed window, click the New IP addresses range button to display the Add IP Range window.

3 Fill in the fields provided (the Class ID, Start IP address, and Subnet mask fields are mandatory) and click OK. The example below illustrates how to create network class 2 matching all IP addresses in the range from `10.0.0.0` to `10.255.255.255`:

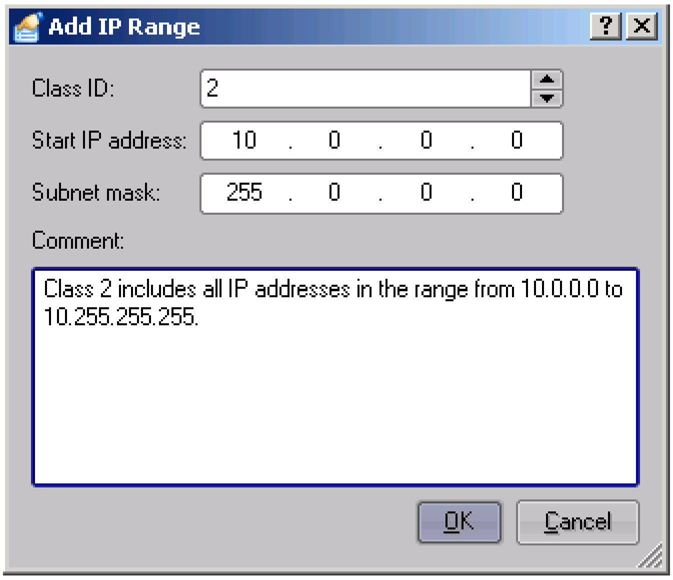

Figure 50: Management Console - Configuring Network Classes

After you click OK in the Add IP Range window, network class 2 will be created and displayed in the table on the Traffic Accounting and Shaping screen. To edit or delete the newly created class or any other existing classes, use the corresponding buttons on the Accounting tab in the Traffic Accounting and Shaping window.

Note: After editing the `/etc/vz/conf/networks_classes` file manually (i.e. without the help of Parallels Management Console), you should execute either the `/etc/init.d/vz accrestart` or `service vz accrestart` command for the changes made to the file to take effect.

Viewing Network Traffic Statistics

The Virtuozzo Containers software allows you to view the current network traffic statistics with the help of the `vznetstat` command. The session below shows the traffic statistics for Container 101:

```
# vznetstat -v 101
CTID  Net.Class  Input(bytes) Input(pkts)  Output(bytes) Output(pkts)
101       1           2202448       19527       9081832        19584
101       2                 0           0             0            0
```

In this case, around 2 Mb of data were uploaded to the Container and about 9 Mb were downloaded from it. All the traffic matches the definition of Class 1 and no data was exchanged with any hosts from Class 2 networks.

Without specifying Container ID with the `–v` parameter, the command will display the statistics for all running Containers.

In Parallels Management Console, you can view the current network traffic statistics for a Container by performing the following operations:

1 Open the needed Container manager window by double-clicking the corresponding Container line in the right pane of the Management Console window;
2 Expand the **Monitor** item and select the **Network** folder. You can now see the network traffic statistics for the given Container in the right pane of the window.

Turning On and Off Network Bandwidth Management

Traffic shaping also known as network bandwidth management allows you to control what network bandwidth a Container receives for outgoing traffic. Traffic shaping is off by default in Parallels Virtuozzo Containers and is controlled by the `TRAFFIC_SHAPING` variable in the Virtuozzo global configuration file (`/etc/vz/vz.conf`).

Note: Container incoming traffic cannot be controlled in Virtuozzo Containers 4.0.

In order to turn traffic shaping on, you have to complete the following steps:

- Set the value of `TRAFFIC_SHAPING` to "yes" in the Virtuozzo global configuration file;
- Correctly set up the `BANDWIDTH` and `TOTALRATE` parameters values;
- Start traffic shaping with the `/etc/init.d/vz shaperon` command.

The `BANDWIDTH` variable is used for specifying the network rate (in kilobits per second) of available network adapters. By default, it is set to "`eth0:102400`", which corresponds to a 100Mb/s Fast Ethernet card. If your Hardware Node has more network adapters installed, you need to update this variable to list all the adapters participating in shaping. For example, in case of two Fast Ethernet cards this variable shall be set to "`eth0:102400 eth1:102400`".

The `TOTALRATE` variable specifies the size of the so-called bandwidth pool for each network class being shaped. The bandwidth from the pool can be borrowed by Containers when they need more bandwidth for communicating with hosts from the corresponding network class. It is used to limit the total available outgoing traffic Containers can consume; the next section explains it in more detail. The format of this variable is "*`<NIC>`*`:`*`<network_class>`*`:`*`<bandwidth_in_Kbits_per_second>`*" and defines the pool size per network class for a given network adapter. Multiple entries for different network classes and adapters shall be separated by spaces. The default value for `TOTALRATE` is "`eth0:1:4096`", which corresponds to the pool size of 4Mb/s for Network Class 1 on the first Ethernet adapter.

In the Virtuozzo global configuration file, you may also define the `RATE` variable whose value amounts to the number of kilobits per second any Container is guaranteed to receive for outgoing traffic with a network class on an Ethernet device. The default value of this parameter is "`eth0:1:8`", which means that any Container is guaranteed to receive the bandwidth of at least 8 Kbits/s for sending data to Class 1 hosts on the first Ethernet device. This bandwidth is not the limit for a Container (unless the `RATEBOUND` parameter is set to "yes" in the Container configuration file) – the Container is able to take the needed bandwidth from the `TOTALRATE` bandwidth pool if it is not used by other Containers.

After setting up the above variables, start bandwidth management as is illustrated below:

```
# /etc/init.d/vz shaperon
Starting Virtuozzo shaping: Ok
Set shaping on running Container :
vz WARNING: Can't get tc class for Container(101).
vz WARNING: Can't access file /var/run/vz_tc_classes. \
Creating new one.
vz WARNING: Can't get tc class for Container(1).
```

Now you have activated the network bandwidth limits. To turn traffic shaping off temporarily, use the `/etc/init.d/vz shaperoff` command. If you want to disable bandwidth management permanently, set the `TRAFFIC_SHAPING` variable to "no" in the Virtuozzo global configuration file.

Parallels Management Console provides a convenient means for turning on/off network bandwidth management on the **Shaping** tab of the **Traffic Accounting and Shaping** window, which you can access by doing the following:

1 In the left pane of the Management Console window, right-click the needed Node and select **Network Configuration --> Configure Traffic Accounting and Shaping** on the context menu.

2 Go to the **Shaping** tab of the displayed window:

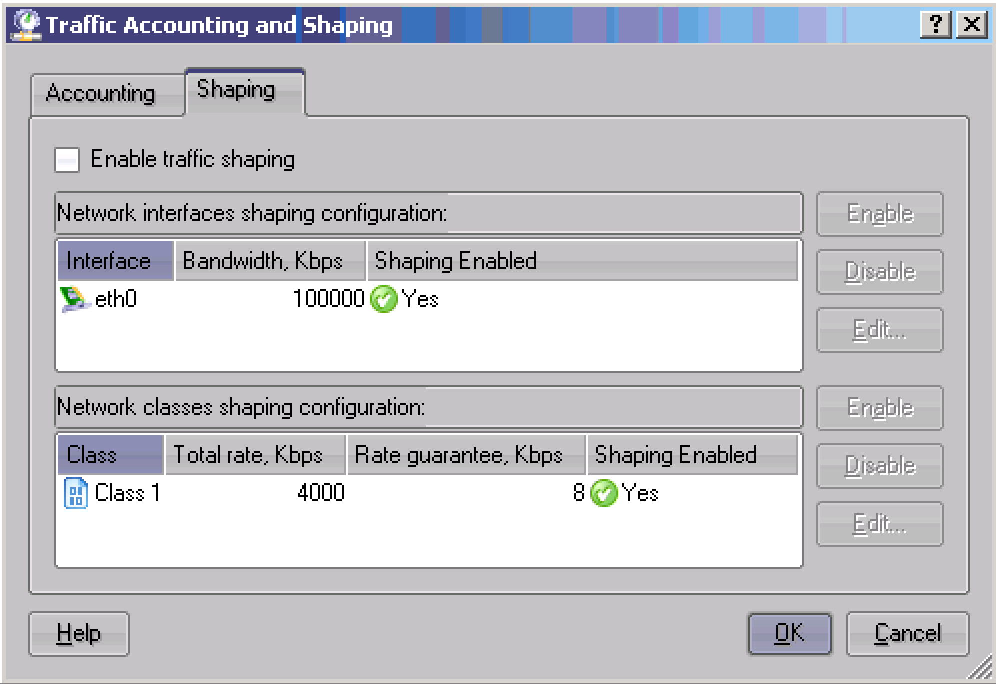

Figure 51: Management Console - Setting Up Traffic Shaping Parameters

In this window you can:

- enable/disable traffic shaping by selecting/deselecting the **Enable traffic shaping** check box
- add/edit/delete a network class for traffic shaping
- set up the `BANDWIDTH` parameter value for each Ethernet device
- set up the `TOTALRATE` parameter value for each network class
- set up the `RATE` parameter value which is the default network bandwidth guarantee for any Container sending data to the given network class.

The traffic shaping settings will take effect immediately on your clicking the **OK** button in this window.

Configuring Network Bandwidth Management for Container

The network bandwidth for outgoing traffic a Container receives is controlled by two variables in the Container configuration file (`/etc/vz/conf/<CT_ID>.conf`): `RATE` and `RATEBOUND`.

Note: Container incoming traffic cannot be controlled in Virtuozzo 4.0.

The `RATE` variable has the same format as `TOTALRATE`: "`<NIC>:<network_class>:<bandwidth>`". This variable specifies the guaranteed outgoing traffic rate that the corresponding Container receives. This rate can be specified differently for different network classes and network adapters; use space to separate several rate descriptions.

Bandwidth values are specified in Kbit/s. It is recommended to increase this value in 8Kbit/s chunks and to set it no lower than 8Kbit/s.

The `RATEBOUND` variable specifies whether the network bandwidth available to the Container for outgoing traffic is limited by the bandwidth specified in the `RATE` variable. The possible values of the `RATEBOUND` variable are "yes" and "no", the default is "no". In this case the Container is allowed to take free bandwidth from the `TOTALRATE` pool.

The actual network bandwidth available to the Containers depends on the number of Containers and the total sum of the `RATE` values, and normally does not coincide with the bandwidth specified in their own `RATE` variables. If the `RATEBOUND` variable is set to "yes", then the Container bandwidth is limited by the value of the `RATE` variable.

If the Container configuration file does not specify any of these parameters, the values from the Virtuozzo global configuration file are taken. By default, Virtuozzo Containers does not set `RATEBOUND`, which corresponds to "no", and `RATE` is set to "`eth0:1:8`".

Virtuozzo network bandwidth management works in the following way. The bandwidth pool for a given network class (configurable through the `TOTALRATE` variable in the Virtuozzo global configuration file) is divided among the Containers transmitting data proportionally to their `RATE` settings. If the total value of the `RATE` variables of all Containers transmitting data does not exceed the `TOTALRATE` value, each Container gets the bandwidth equal or greater than its `RATE` value (unless this Container has the `RATEBOUND` variable set to "yes"). If the total value of the `RATE` variables of all Containers transmitting data exceeds the `TOTALRATE` value, each Container may get less than its `RATE` value.

The example below illustrates the scenario when there are two Containers, 101 and 102, which have `RATEBOUND` set to "no", and Container 103 has `RATEBOUND` set to "yes":

```
# grep ^RATE /etc/vz/conf/101.conf /etc/vz/conf/102.conf
RATE="eth0:1:8"
RATEBOUND=”no”
RATE="eth0:1:8"
RATEBOUND=”no”
# grep ^RATE /etc/vz/conf/103.conf
RATE="eth0:1:64"
RATEBOUND=”yes”
```

With the default `TOTALRATE` of 4096Kbit/s, bandwidth pool will be distributed according to the following table:

Container 101	Container 102	Container 103	Bandwidth consumed by Containers
transmits	idle	idle	Container101: 4096Kbits/s
idle	idle	transmits	Container103: 64Kbits/s
transmits	transmits	idle	Container101: 2048Kbits/s Container102: 2048Kbits/s
transmits	idle	transmits	Container101: 4032Kbits/s Container103: 64Kbits/s
transmits	transmits	transmits	Container101: 2016Kbits/s Container102: 2016Kbits/s Container103: 64Kbits/s

After you have set up Container bandwidth settings, activate your changes as below:

```
# /etc/init.d/vz shaperrestart
Stopping Virtuozzo shaping: Ok
Starting Virtuozzo shaping: Ok
Set shaping on running Container: Ok
```

This command clears off all existing shaping settings and sets them again using the configuration files of running Containers.

By means of Parallels Management Console, you can provide the network bandwidth settings for a particular Container on the **Resources** tab of the **Properties of Container** window, which you can access by doing the following:

1 Click **Virtuozzo Containers** in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.

2 Go to the **Network** tab of the displayed window and select the **Traffic Shaping** item.

In the displayed window you can:

- add/edit/delete a network class for traffic shaping
- set up the `RATE` guarantee parameter value for the given Container for any network class
- set the value for the `RATEBOUND` parameter for the given Container by selecting/clearing the **Rate guarantee is also a bound** check box
- scale the traffic shaping configuration.

The traffic shaping settings will take effect immediately on your clicking the **OK** button in this window.

Managing System Parameters

The given section provides information on how you can manage the system resource parameters, which a Container may allocate, using the Virtuozzo Service Level Management (SLM) system. This system allows you to easily and effectively configure and control all memory-related parameters inside Containers.

Note: You can also set memory limits for and provide memory guarantees to Containers by configuring multiple UBC (User Beancounter) parameters (`numproc`, `numtcpsock`, `vmguarpages`, etc.). These parameters provide you with comprehensive facilities of customizing the memory resources in respect of your Containers; however, this way of managing system resources is more complex and requires more effort to be made on your part to adopt it to your system. For detailed information on UBC parameters, please turn to Managing UBC Resources in Parallels Virtuozzo Containers shipped with Virtuozzo Containers 4.0.

Overview

Virtuozzo Service Level Management (SLM) is a special system allowing you to configure and control the service levels provided to Container users. SLM can be used to manage the Container memory resources, i.e. to adjust the amount of memory that any Container on the Hardware Node is allowed to consume. The SLM scheme introduced in Virtuozzo Containers 3.0 for the first time has been developed to replace the UBC scheme of managing system resources parameters and, thus, to simplify the resources management inside Containers by uniting all memory-related parameters into a single `slmmemorylimit` parameter.

Note: Detailed information on all UBC parameters is provided in the Managing UBC Resources in Parallels Virtuozzo Containers guide shipped with Virtuozzo Containers 4.0.

SLM can be used to ensure that:

- The memory consumption by every Container on the Hardware Node does not exceed its instant memory limit.
- The memory usage by every Container on the Hardware Node does not exceed its average limit.
- The total memory consumption by all Containers does not exceed the amount of memory available on the Hardware Node and prevents the total memory from reaching the point when the Node performance begins to significantly degrade.
- The 'low memory' usage by all Containers on the Hardware Node does not leave the safe range.

Computing Memory Usage in SLM

As a Hardware Node administrator, you may often need to properly set the amount of memory this or that Container will be allowed to consume and, therefore, should have a clear idea of the memory computation mechanism used in the SLM scheme. On the whole, the memory usage inside every particular Container for which the SLM functionality is enabled is calculated in the same way as it would be done on a standalone server. It means that the same set of applications running inside a Container will require approximately the same amount of RAM for their functioning as it would require on any other standalone server. Consequently, the amount of memory to be allocated to any Container largely depends on the number of applications you are going to deploy inside the Container and their memory requirements. For example, if you are going to use your Container as a web server only, there is no need to allocate much RAM to this Container (e.g. no more than 50 Mb). At the same time, running such memory intensive applications as MySQL, Perl, PHP requires the memory limit be set to no less than 300 Mb.

The situation above provides only the general description of memory usage inside Containers. In fact, the process of memory computation used in the SLM scheme is more complicated. It includes the calculation of the `oomguarpages`, `kmemsize`, `lockedpages`, and `socket buffer` parameters and the unification of these parameters into a single `slmmemorylimit` parameter. It also assumes a number of accounting rules to be taken into consideration while deciding on the amount of memory to be allocated to a Container. The main rules are given below:

- The memory allocated to a Container includes both memory itself and the swap space.
- The memory consumption inside a Container is calculated by taking into account the data sharing among applications. So, if two Containers share one and the same memory page, each Container is considered to consume half a page. As the number of Containers sharing the same memory pages grows, the memory consumption inside each of these Containers decreases. Thus, an application running inside a Container can consume much less memory than the identical application launched in the Host OS or on a standalone server. Especially much data can be shared when Containers use the same versions of applications and shared libraries (e.g. in the case of using the same versions of the `apache` Web server with the same set of modules and the same versions of system libraries). In such cases the difference in memory usage may reach tens of megabytes.
- The total amount of used memory and swap space in the system is computed on the basis of the memory consumption inside all Containers plus memory usage in the Host OS.

Controlling Memory Usage by Container

SLM has a number of means at its disposal allowing it to effectively control and configure the memory usage on the Hardware Node and inside all its Containers. These means include:

a Using the `free` command to check the memory limit set for a Container and the current memory consumption inside this Container. If the SLM functionality is disabled, running this command inside your Containers will display the total and used memory on the Hardware Node.

b Restricting the rate of creating new processes and threads inside a Container.

c Denying memory allocation requests from a Container.

d Sending the `SISTERM` signal to applications intensively consuming the memory and requesting them to terminate all their operations, save the data, and exit.

e Killing a 'dangerous' application by sending the `SIGKILL` signal to it.

Various means of managing the Container memory consumption on the Node makes SLM more application-friendly as compared to the management scheme by means of UBC parameters (the latter has only the methods described in items `c` and `e` at its disposal). This allows SLM to select the right means while deciding on the steps to be taken in respect of this or that application. Among other things, SLM takes into account the following characteristics:

- the severity of the memory limit excess;
- the duration and frequency of the excesses.

SLM Modes

SLM is automatically enabled during the Virtuozzo Containers installation on the Hardware Node, i.e. you do not have to perform any additional operations to start using this functionality on your Node. However, the Virtuozzo Containers software allows you to manage SLM in one of the following ways:

- Disable SLM on a global basis. In this case no Container on the Hardware Node will be able to make use of this functionality. To disable SLM, you should complete the following tasks:
  - Specify 'no' as the value of the `SLM` parameter in the Virtuozzo global configuration file - `/etc/vz/vz.conf`.
  - Reboot the Hardware Node, e.g:

```
# shutdown -r now
```

- Control the SLM mode for a particular Container on the Node. The current version of Parallels Virtuozzo Containers allows you to set one of the following SLM modes for your Container:
  - *limited mode*. In this mode the SLM functionality for the corresponding Container is enabled and can be used to control the 'total' and 'low' memory consumption by all Containers on the Hardware Node, which prevents the memory from being overused and guarantees reliable performance of the Node. At the same time, you can use various UBC parameters to manage particular resources of the Container. If the Container does not have any UBC parameters set, SLM also undertakes the control over the consumption of these resources by this Container. By default, any Container created on the Hardware Node is functioning in the *limited mode*. If your Container is working in another mode, you can return it to this mode by executing the `vzctl set` command and passing the `--slmmode all` option to it.
  - *full mode*. In this mode the SLM functionality for the corresponding Container is enabled and can be used to the full extent for managing the amount of memory which can be allocated to and consumed by the Container. Enabling the *full mode* automatically sets the values of all UBC parameters to 'unlimited'. When functioning in this mode, SLM may significantly improve the resources allocation among individual Containers. For example, it allows you to avoid situations when the memory allocation for some application inside the Container fails although the system has a lot of free resources. The *full mode* can be set by using the `--slmmode slm` option with the `vzctl set` command.

- *compatibility mode*. In this mode the SLM functionality for the corresponding Container is disabled and the system resources control management is performed by using UBC parameters only: `numproc`, `numtcpsock`, `numothersock`, `vmguarpages`, `kmemsize`, etc. Detailed information on all UBC parameters is provided in the Managing UBC Parameters section. The *compatibility mode* can be set by using the `--slmmode ubc` option with the `vzctl set` command.

Note: You can also enable any of the aforementioned modes by editing the Container configuration file and setting the corresponding value (`all`, `slm`, or `ubc`, respectively) of the `SLM` parameter in this file.

Managing Container Memory Usage

The SLM mechanism allows you to manage the amount of memory a Container can consume by configuring a single parameter - `slmmemorylimit`. This significantly simplifies the process of memory management on the Hardware Node and inside its Containers and represents the main SLM advantage over the old memory management mechanism (implemented on the basis of multiple UBC parameters). You can set or configure the Container memory usage limit by means of the `--slmmemorylimit` parameter of the `vzctl set` command.

Let us assume that you wish to use SLM to manage the amount of memory which can be consumed by Container 101 and set its memory limit to 100 Mb. This can be done by executing the following command:

```
# vzctl set 101 --slmmemorylimit 102400000
Saved parameters for Container 101
```

By default, the memory limit to be allocated to your Container is set in bytes; however, you can change the default units of measurement by adding the following symbols after the value:

- `K`: specifying this symbol after the value allows you to set the Container memory limit in kilobytes (e.g. `1000K`).
- `P`: specifying this symbol after the value allows you to set the Container memory limit in pages (e.g. `200P`).
- `M`: specifying this symbol after the value allows you to set the Container memory limit in megabytes (e.g. `100M`).
- `G`: specifying this symbol after the value allows you to set the Container memory limit in gigabytes (e.g. `1G`).

After the memory limit has been successfully set for Container 101, you can view it by running the `free` command inside this Container:

```
# vzctl exec 101 free
             total    used    free  shared  buffers  cached
Mem:        102400   46216   56184       0    10532   27748
-/+ buffers/cache:   17936   49748
Swap:       204800       0  204800
```

As can be seen from the example above, the specified memory limit is shown as the total memory available to Container 101.

In Parallels Management Console, to view and/or change the amount of memory for a particular Container, do the following:

1. Select the **Virtuozzo Containers** item in the Management Console left pane, right-click the needed Container in the right pane, and choose **Properties**.
2. Click the **Resources** tab and select **System parameters**.
3. In the **Parameters** table, double-click the `slmmemorylimit` parameter, and, if necessary, specify the right value for the given Container.
4. Click **OK**.

Grouping Applications Inside Container

SLM provides a mechanism of classifying available applications (or processes representing instances of these running applications) inside a Container, uniting them into certain groups, and ensuring a sort of isolation among these groups. Such application grouping allows you to separately control each application group and, if the Container exceeds its memory limit and some application group inside this Container overuses the memory, to reduce the memory consumption only by the corresponding application group rather than to impose memory restrictions on the whole Container and all its applications. For example, this can help you keep the remote SSH connection to your Container in the case of the `apache` Web server misbehaviour or keep this Web service working if the 'dangerous' application is the `sendmail` service.

In the current version of Parallels Virtuozzo Containers, all applications (processes) inside a Container are by default included in one of the following groups:

- '`other`' (also referred to as group 0): this group contains all the processes not included in the '`daemons`', '`httpd`', and '`mysql`' groups. The termination of any process belonging to this group affects certain (usually uncritical) Container functionality only and does not lead to the entire Container DoS (denial of service).
- '`daemons`' (also referred to as group 1): this group includes `init`, `rc`, and all system daemons (e.g. `sshd`). The '`daemons`' group is the most important one and provides the basis for the Container functioning.
- '`httpd`' (also referred to as group 2): this group includes the `apache` Web server only. The processes in this group and the '`mysql`' one provide the main workload of any Container.
- '`mysql`' (also referred to as group 3): this group includes the MySQL database server only. The processes in this group and the '`httpd`' one provide the main workload of any Container.

By default, any new process inherits the group from its parent process. For example, all children of the `httpd` process are placed to the '`httpd`' group whereas all children of the '`mysql`' process are included in the '`mysql`' group. However, the group of a process can be changed during its forking and/or execution on the basis of special SLM pattern rules. The default SLM pattern rules are specified in the `/etc/vzslm.d/default.conf` file on the Hardware Node in the table having the following four columns:

- *`first_column`*: the name of the process to which the rule is to be applied.
- *`second_column`*: a bitwise set of values defining the scheme on the basis of which the process is to be moved to the corresponding group.
- *`third_column`*: the group the process belongs to before the rule is applied. The `-1` value, if specified, means any group.
- *`fourth_column`*: the group where the process will be moved after the rule is applied.

The *`flags`* field represents a number containing one or several of the following bitwise values:

Hexadecimal Notation	Binary Notation	Description

`0x0001`	`|_0_|_0_|_0_|_0_|_0_|_0_|_0_|_1_|`	This bit, if set to 1, indicates that the rule is to be applied to the process if it is a daemon.
`0x0002`	`|_0_|_0_|_0_|_0_|_0_|_0_|_1_|_0_|`	This bit, if set to 1, indicates that the rule is to be applied to the process if it is not a daemon.
`0x0004`	`|_0_|_0_|_0_|_0_|_0_|_1_|_0_|_0_|`	This bit, if set to 1, indicates that the rule is to be applied to the process during its forking (i.e. on the `fork()` call).
`0x0008`	`|_0_|_0_|_0_|_0_|_1_|_0_|_0_|_0_|`	This bit, if set to 1, indicates that the rule is to be applied to the process during its execution (i.e. on the `exec()` call).
`0x0010`	`|_0_|_0_|_0_|_1_|_0_|_0_|_0_|_0_|`	This bit, if set to 1, indicates that the name of the process is to be checked before applying the rule.

Let us take as an example the following rule from the `/etc/vzslm.d/default.conf` file

```
"httpd"  0000001c  -1  2
```

and examine what processes are affected by this rule and in what way. The flags in this rule (`0000001c` or `|_0_|_0_|_0_|_1_|_1_|_1_|_0_|_0_|` in the binary notation) involve checking the name of the process (the fifth bit from the right equals `1`) and, if this name is `httpd`, moving the process to the '`httpd'` group (*`destination_subgroup`* = `2`) regardless of the group it originally belongs to (*`source_subgroup`* = `-1`) during the process forking and execution (the third and forth bits from the right equal `1`).

The following table lists all the rules present in the `/etc/vzslm.d/default.conf` file shipped with Virtuozzo Containers 4.0:

Rule Name		Explanation
`#1 "init"`	`00000018 -1 9`	If the process has the name of `init`, move it to group 9 during the process execution irrespective of the group it originally belongs to. As there is no default group numbered 9, it will be created when this rule is first applied.
`#2 "httpd"`	`0000001c -1 2`	If the process has the name of `httpd`, move it to group 2 during the process forking and execution irrespective of the group it originally belongs to.

`#3 "httpsd"`	`0000001c -1 2`	If the process has the name of `httpsd`, move it to group 2 during the process forking and execution irrespective of the group it originally belongs to.
`#4 "lighthttpd"`	`0000001c -1 2`	If the process has the name of `lighthttpd`, move it to group 2 during the process forking and execution irrespective of the group it originally belongs to.
`#5 "mysqld"`	`0000001c -1 3`	If the process has the name of `mysqld`, move it to group 3 during the process forking and execution irrespective of the group it originally belongs to.
`#6 "syslogd"`	`00000018 0 8`	If the process has the name of `syslogd` and originally belongs to group 0, move it to group 8 during the process execution.
`#7 "sshd"`	`00000018 0 8`	If the process has the name of `sshd` and originally belongs to group 0, move it to group 8 during the process execution.
`#8 "inetd"`	`00000018 0 8`	If the process has the name of `inetd` and originally belongs to group 0, move it to group 8 during the process execution.
`#9 "xinetd"`	`00000018 0 8`	If the process has the name of `xinetd` and originally belongs to group 0, move it to group 8 during the process execution.
`#10 "cron" 8`	`00000018 0`	If the process has the name of `cron` and originally belongs to group 0, move it to group 8 during the process execution.
`#11 "crond" 8`	`00000018 0`	If the process has the name of `crond` and originally belongs to group 0, move it to group 8 during the process execution.
`#12 "" 0`	`00000004 9`	If the process originally belongs to group 9, move it to group 0 during the process forking. As there is only one process belonging to group 9 - `init`, this rule will be applied to the `init` children only (see `#1`).
`#13 "" 1`	`00000004 8`	If the process originally belongs to group 8, move it to group 1 during the process forking.
`#14 "" 0`	`00000004 1`	If the process originally belongs to group 1, move it to group 0 during the process forking.

Note: As all processes (parents) in rules `#6 - #11` belong to group 1, the instances these rules can be applied to can only be children (see rule `#14`).

During its life cycle, any process running inside the Container is checked against the available rules in the `/etc/vzslm.d/default.conf` file from top to bottom and the first matching rule is applied to it. So, if the following 2 rules are present in the `default.conf` file

```
"httpd"  0000001c  -1  2
"httpd"  00000016  -1  1
```

the first rule (`"httpd"  0000001c  -1  2`) will be applied to all `httpd` processes inside all Containers on the Hardware Node.

You can create your own SLM pattern configuration files with your own rules and apply them to particular Containers on the Node. For example, if you wish Container 101 to start using a configuration file different from `/etc/vzslm.d/default.conf`, you can proceed as follows:

1 Create a new file with an arbitrary name and the `.conf` extension (e.g. by means of `vi`) and place it to the `/etc/vzslm.d` directory on the Hardware Node.

2 Make Container 101 use the newly created configuration file. Assuming that the configuration file name is `light.conf`, you can do it by issuing the following command on the Node:

```
# vzctl set 101 --slmpattern light --save
Saved parameters for Container 101
```

Note: If you wish to make all Containers on the Node use another SLM pattern configuration file, you should specify the name of this file without the `.conf` extension (e.g. `light`) as the value of the `SLMPATTERN` parameter in the global Virtuozzo configuration file (`/etc/vz/vz.conf`).

Managing Container Resources Configuration

Any Container is configured by means of its own configuration file. You can manage your Container configurations in a number of ways:

1 Using configuration sample files shipped with Virtuozzo Containers 4.0. These files are used when a new Container is being created (for details, see the Creating and Configuring New Container section (p. 34)). Currently, the following configuration sample files are provided:

- `basic` – to be used for creating standard Containers;
- `confixx` – to be used for creating Containers that are to use the Confixx control panel;
- `cpanel` - to be used for creating Containers where the CPanel application is to be installed;
- `oracle` - to be used for creating Containers that are to run Oracle database servers;
- `slm.plesk` - to be used for creating Containers with the Plesk control panel;
- `slm.256MB` - to be used for creating Containers with 256 Mb of main memory;
- `slm.512Mb` - to be used for creating Containers with 512 Mb of main memory;
- `slm.1024Mb` - to be used for creating Containers with 1024 Mb of main memory;

- `slm.2048Mb` - to be used for creating Containers with 2048 Mb of main memory.

Note: Configuration sample files cannot contain spaces in their names.

Any sample configuration file may also be applied to a Container after it has been created. You would do this if, for example, you want to upgrade or downgrade the overall resources configuration of a particular Container:

```
# vzctl set 101 --applyconfig basic --save
```

This command applies all the parameters from the `ve-basic.conf-sample` file to the given Container.

Important! When you install the Parallels Virtuozzo Containers software on your Hardware Node, the default Container samples having the `ve-<name>.conf-sample` names are put to the `/etc/vz/conf` directory. As you first start working in Virtuozzo Containers 4.0, these samples are automatically copied to the `/var/vzagent/etc/samples` directory (leaving the original samples versions intact) where they are converted to a special XML-based format that can be understood by Virtuozzo tools (Parallels Infrastructure Manager and Parallels Management Console). In this connection you should keep in mind the following when working with Container samples:

- When you create a Container by means of Virtuozzo tools and base it on some Container sample, this sample is taken from the `/var/vzagent/etc/samples` directory.
- When you create a Container using the `vzctl create` command utility and base it on some Container sample, this sample is taken from the `/etc/vz/conf` directory.
- If you modify an existing Container sample or create a new sample using Virtuozzo tools, the changes are made to the corresponding sample located in the `/var/vzagent/etc/samples` directory or the resulting Container sample is put to this directory.
- If you modify an existing Container sample or create a new sample using certain Virtuozzo command line utilities (e.g. `vzsplit`, `vzcfgscale`), the changes are made to the corresponding file in the `/etc/vz/conf` directory or the resulting Container sample is put to this directory.

2 Using Virtuozzo specialized utilities for preparing configuration files in their entirety. The tasks these utilities perform are described in the following subsections of this section.

3 The direct creating and editing of the corresponding Container configuration file (`/etc/vz/conf/<CT_ID>.conf`). This can be performed either with the help of any text editor or through Parallels Management Console. The instructions on how to edit Container configuration files directly are provided in the four preceding sections. In this case you have to edit all the configuration parameters separately, one by one.

Changes From Virtuozzo 3.0

The configuration sample files shipped with Virtuozzo 3.0 have undergone the following changes in Virtuozzo Containers 4.0:

- All the configurations samples have been renamed as follows:

Virtuozzo Containers 3.0	Virtuozzo Containers 4.0
`vps.basic`	`basic`

vps.confixx	confixx
vps.cpanel	cpanel
db.oracle	oracle
vps.plesk7.rh9	slm.plesk
vps.256MB	slm.256MB
vps.512MB	slm.512MB
vps.1024MB	slm.1024MB
vps.2048MB	slm.2048MB

- The `vps.basic` default configuration sample set in the Virtuozzo global configuration file and used in Virtuozzo 3.0 for creating Containers is replaced with the `basic` configuration sample.
- The `unlimited.db2` configuration sample is not shipped any more.
- The resources values of the following configuration samples have been changed in Virtuozzo Containers 4.0:
  - `ve-vps.1024MB.conf-sample;`
  - `ve-vps.2048MB.conf-sample;`
  - `ve-vps.256MB.conf-sample;`
  - `ve-vps.512MB.conf-sample;`
  - `ve-vps.plesk7.rh9.conf-sample.`

  As a result, these configuration sample files are moved to the `/etc/vz/conf/old_configs` directory on the Hardware Node when upgrading to Virtuozzo Containers 4.0. So, you cannot use them in Virtuozzo Containers 4.0 as the basis for the Container creation. If you, however, wish to continue using any of these templates, you can proceed as follows:

  a Create a new configuration sample file and base it on the corresponding old configuration sample.

  b Copy the needed configuration sample from the `/etc/vz/conf/old_configs` directory to the `/etc/vz/conf` directory on the Hardware Node. For example:

```
# cp /etc/vz/conf/old_configs/ve.vps.plesk7.rh9.conf-sample
     /etc/vz/conf
```

  After executing these commands, you will be able to use `vps.plesk7.rh9` configuration sample in the same way you would use it in Virtuozzo 3.0.

Splitting Hardware Node Into Equal Pieces

It is possible to create a Container configuration roughly representing a given fraction of the Hardware Node. If you want to create such a configuration that up to 20 fully loaded Containers would be able to be simultaneously running on the given Hardware Node, you can do it as is illustrated below:

```
# cd /etc/vz/conf
# vzsplit -n 20 -f mytest
Config /etc/vz/conf/ve-mytest.conf-sample was created
```

Note that the configuration produced depends on the given Hardware Node resources. Therefore, it is important to validate the resulted configuration file before trying to use it, which is done with the help of the `vzcfgvalidate` utility. For example:

```
# vzcfgvalidate ve-mytest.conf-sample
Recommendation: kmemsize.lim-kmemsize.bar should be > 253952 \
(currently, 126391)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 93622)
```

The number of Containers you can run on the Hardware Node is actually several times greater than the value specified in the command line because Containers normally do not consume all the resources that are guaranteed to them. To illustrate this idea, let us look at the Container created from the configuration produced above:

```
# vzctl create 101 --ostemplate redhat-el5-x86 --config mytest
Creating Container private area (redhat-el5-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area created
Container registered successfully
# vzctl set 101 --ipadd 192.168.1.101 --save
Saved parameters for Container 101
# vzctl start 101
Starting Container ...
Container is mounted
...
# vzcalc 101
Resource     Current(%)  Promised(%)  Max(%)
Memory           0.53       1.90       6.44
```

As is seen, if Containers use all the resources guaranteed to them, then around 20 Containers can be simultaneously running. However, taking into account the **Promised** column output, it is safe to run 40-50 such Containers on this Hardware Node.

There is a possibility to create a suchlike configuration sample file using Parallels Management Console:

1. Right-click the **Container Samples** item in the Hardware Node main tree and select **"Slice" Hardware Node** on the context menu.
2. Follow the instructions of the wizard.

When creating a new Container configuration sample by splitting Hardware Node resources, please keep in mind the following:

- If you generate a Container configuration sample using the `vzsplit` command line utility, the resulting Container sample is put to the `/etc/vz/conf` directory. This sample can then be used by `vzctl create` when creating a new Container on its basis.

- If you generate a Container sample by splitting Hardware Node resources via Virtuozzo tools, the resulting Container sample is put to the `/var/vzagent/etc/samples` directory. This sample can then be used by Virtuozzo tools when creating a new Container on its basis.

Scaling Container Configuration

Any configuration or configuration sample file can prove insufficient for your needs. You might have an application, which does not fit into existing configurations. The easiest way of producing a Container configuration is to scale an existing one.

Scaling produces a “heavier” or “lighter” configuration in comparison with an existing one. All the parameters of the existing configuration are multiplied by a given number. A heavier configuration is produced with a factor greater than 1, and a lighter one – with a factor between 0 and 1.

Note: If you create a new sample on the basis of an existing sample using the `vzcfgscale` command line utility, the resulting Container sample is put to the `/etc/vz/conf` directory. This sample can then be used by `vzctl create` when creating a new Container on its basis.

The session below shows how to produce a configuration sample 50% heavier than the `basic` configuration shipped with Parallels Virtuozzo Containers:

```
# cd /etc/vz/conf
# vzcfgscale -a 1.5 -o ve-improved.conf-sample ve-basic.conf-sample
# vzcfgvalidate ve-improved.conf-sample
Recommendation: kmemsize.lim-kmemsize.bar should be > 245760 \
(currently, 221184)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 98304)
Validation completed: success
```

Now `improved` can be used in the `vzctl create` command for creating new Containers.

It is possible to use the same technique for scaling configurations of the existing Containers. Please note that the output file cannot be the same as the file being scaled. You have to save the scaling results into an intermediate file.

In Parallels Management Console, on the contrary, the scaling results are not written into a new file. If you scale the configuration of a Container, its configuration file is changed without saving the original file. If you scale a configuration sample file, it is correspondingly modified. That is why, it is recommended to create a copy of the configuration sample file you are going to scale before scaling it.

To scale an existing configuration using Parallels Management Console, do the following:

1. Select the **Container Configuration Samples** or **Virtuozzo Containers** option in the Hardware Node main tree.
2. Right-click the sample configuration file or the Container configuration file of which you are going to scale and select **Properties**.
3. Go to the **Resources** tab and click the **Scale** button:

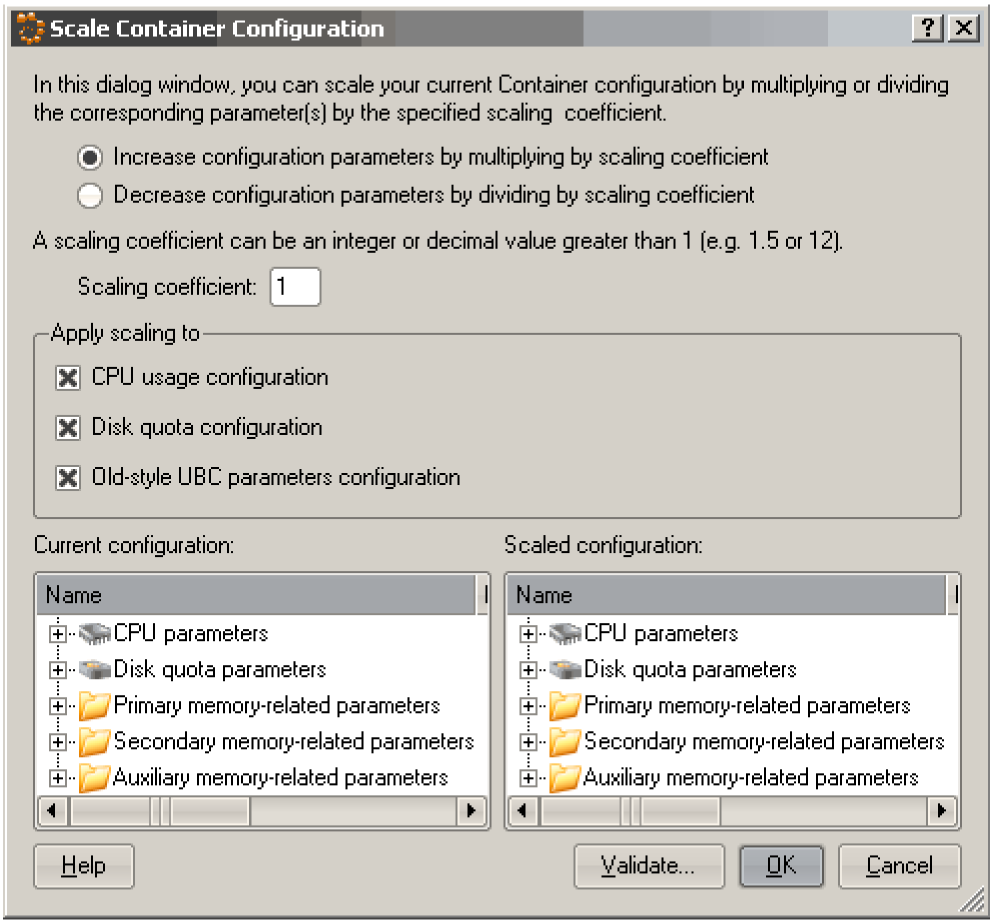

Figure 52: Management Console - Scaling Container Configuration

4 Determine whether you want to enhance or attenuate the current configuration and specify the factor.

5 You may choose what groups of parameters will be scaled under the Apply scaling to group.

6 You are strongly encouraged to validate the resulting configuration with the help of the Validate button before clicking OK.

7 Click OK to save the changes.

Note: If you modify an existing Container sample using Virtuozzo tools (e.g. Parallels Management Console or Parallels Infrastructure Manager), the changes are made to the corresponding sample located in the `/var/vzagent/etc/samples` directory. This sample can then be used by Virtuozzo tools when creating a new Container on its basis.

Validating Container Configuration

The system resource control parameters have complex interdependencies. Violation of these interdependencies can be catastrophic for the Container. In order to ensure that a Container does not break them, it is important to validate the Container configuration file before creating Containers on its basis.

The typical validation scenario is shown below:

```
# vzcfgvalidate  /etc/vz/conf/101.conf
Error: kmemsize.bar should be > 1835008 (currently, 25000)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 65536)
Recommendation: othersockbuf.bar should be > 132096 \
(currently, 122880)
# vzctl set 101 --kmemsize 2211840:2359296 --save
Saved parameters for Container 101
# vzcfgvalidate  /etc/vz/conf/101.conf
Recommendation: kmemsize.lim-kmemsize.bar should be > 163840 \
(currently, 147456)
Recommendation: dgramrcvbuf.bar should be > 132096 (currently, 65536)
Recommendation: othersockbuf.bar should be > 132096 \
(currently, 122880)
Validation completed: success
```

The utility checks constraints on the resource management parameters and displays all the constraint violations found. There can be three levels of violation severity:

Recommendation	This is a suggestion, which is not critical for Container or Hardware Node operations. The configuration is valid in general; however, if the system has enough memory, it is better to increase the settings as advised.
Warning	A constraint is not satisfied, and the configuration is invalid. The Container applications may not have optimal performance or may fail in an ungraceful way.
Error	An important constraint is not satisfied, and the configuration is invalid. The Container applications have increased chances to fail unexpectedly, to be terminated, or to hang.

In the scenario above, the first run of the `vzcfgvalidate` utility found a critical error for the `kmemsize` parameter value. After setting reasonable values for `kmemsize`, the resulting configuration produced only recommendations, and the Container can be safely run with this configuration.

You can also validate any configuration sample file the given Hardware Node has by means of Parallels Management Console. To this effect, do the following:

1 Click the Container Sample item in the Hardware Node name, right-click the needed sample configuration file in the right pane, and select Properties.

2 Select the Resources tab and click the Validate button. A window appears informing you of the results. For example:

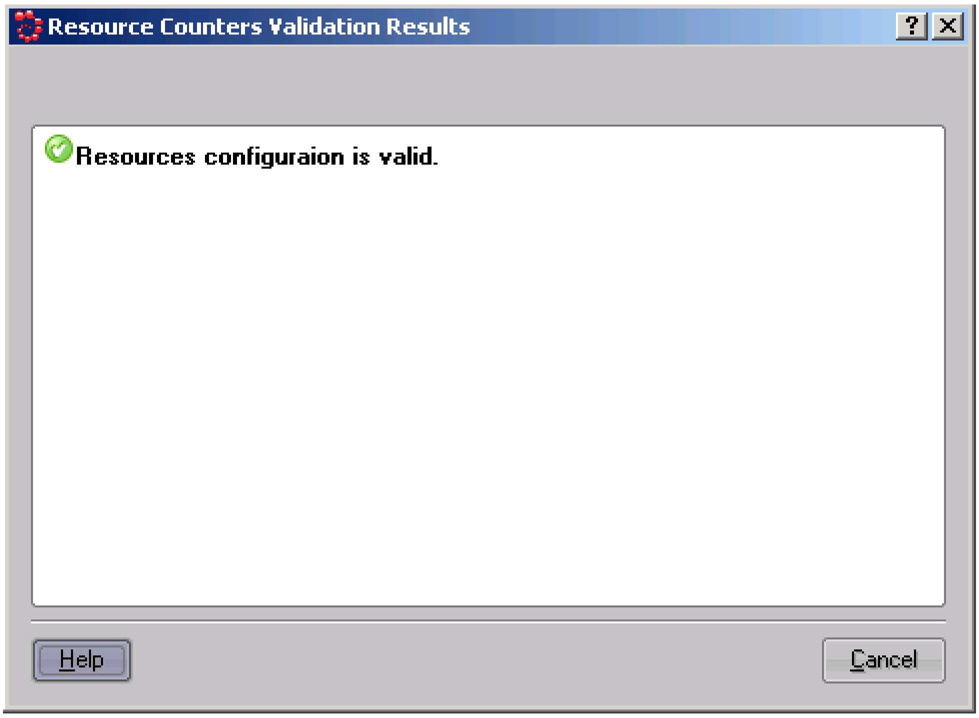

Figure 53: Management Console - Validating Container Sample

In this example the configuration sample verification has passed successfully.

Applying New Configuration Sample to Container

The Virtuozzo Containers software enables you to change the configuration sample file a Container is based on and, thus, to modify all the resources the Container may consume and/or allocate at once. For example, if Container 101 is currently based on the `basic` configuration sample and you are planning to run the Plesk application inside the Container, you may wish to apply the `slm.plesk` sample to it instead of `basic`, which will automatically adjust the necessary Container resource parameters for running the Plesk application inside Container 101. To this effect, you can execute the following command on the Node:

```
# vzctl set 101 --applyconfig slm.plesk --save
Saved parameters for Container 101
```

This command reads the resource parameters from the `ve-slm.plesk.conf-sample` file located in the `/etc/vz/conf` directory and applies them one by one to Container 101.

When applying new configuration samples to Containers, please keep in mind the following:

- All Container sample files are located in the `/etc/vz/conf` directory on the Hardware Node and are named according to the following pattern: `ve-`*`<name>`*`.conf-sample`. You should specify only the *`<name>`* part of the corresponding sample name after the `--applyconfig` option (`slm.plesk` in the example above).
- The `--applyconfig` option applies all the parameters from the specified sample file to the given Container, except for the `OSTEMPLATE`, `TEMPLATES`, `CT_ROOT`, `CT_PRIVATE`, `HOSTNAME`, `IP_ADDRESS`, `TEMPLATE`, `NETIF` parameters (if they exist in the sample file).
- You may need to restart your Container depending on the fact whether the changes for the selected parameters can be set on the fly or not. If some parameters could not be configured on the fly, you will be presented with the corresponding message informing you of this fact.

To apply a new Container configuration sample to a Container in Parallels Management Console, you should perform the following operations:

1. Select the **Virtuozzo Containers** item in the Hardware Node main tree.
2. Right-click the corresponding Container and choose **Tasks** --> **Apply Container Sample** on the context menu to display the **Apply Container Configuration Sample** window:

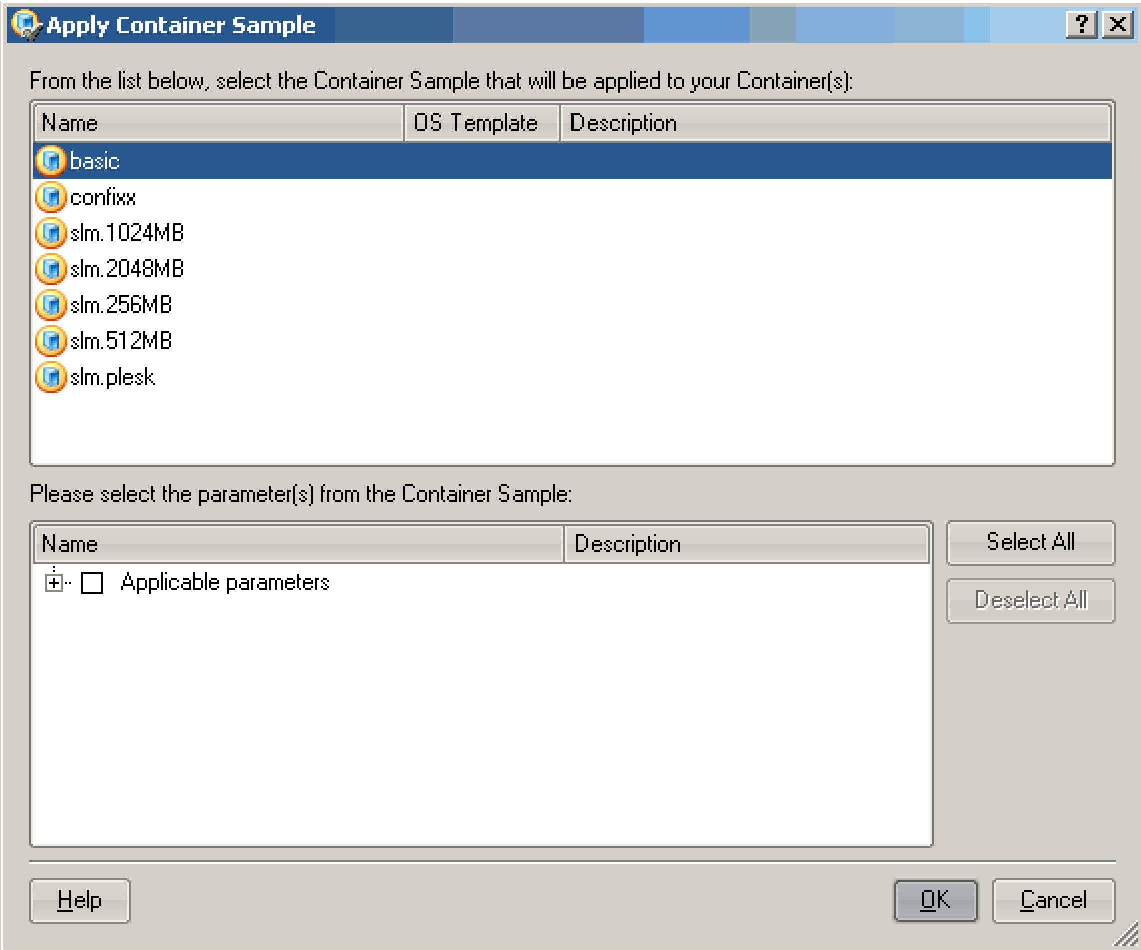

Figure 54: Management Console - Applying New Configuration Sample to Container

3 In this window you should select a new sample file the Container will be based on and the parameters to be changed in accordance with this configuration sample. If you wish to change all the parameters for the Container, select the check box near the **Applicable parameters** item or click the **Select All** button to the right of the table. Otherwise, expand the **Applicable parameters** item and select the check boxes near the parameters to be configured.

4 Click **OK**.

After you have selected a new configuration sample and clicked **OK**, you may need to restart your Container depending on the fact whether the changes for the selected parameters can be set on the fly or not.

Note: Before applying a new Container sample to your Container, make sure you are aware of the resource values defined in this Container template and to be set for the Container. Detailed information on Container samples is provided in the **Managing Container Resources Configurations** section (p. 158).

CHAPTER 5

Real-Time Monitoring in Parallels Virtuozzo Containers

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Monitoring Resources in Text Console

Virtuozzo Containers 4.0 includes quite a number of means to monitor the Hardware Node and Containers resources. One of Virtuozzo's most powerful features is the ability to monitor resources in real time. To this effect, you may run the `vzstat` utility on the Hardware Node, for example, with the following options:

```
# vzstat -d 5 –v
 12:34pm, up 14 days, 18:31,  1 user, load average: 1.00, 1.00, 1.00
CTNum 1, procs  245: R   3, S  228, D   0, Z   0, T  14, X   0
CPU [ OK ]: CTs   0%, CT0  50%, user  31%, sys  19%, idle  50%, lat(ms)  10/0
Mem [CRIT]: total 3940MB, free 962MB/0MB (low/high), lat(ms) 1/0
  ZONE0 (DMA): size 10MB, act 0MB, inact 0MB, free 2MB (0/0/0)
    fragm 5*1 7*2 5*4 4*8 5*16 5*32 4*64 3*128 1*256 1*512 1*1024
  ZONE1 (DMA32): size 2992MB, act 1631MB, inact 179MB, free 957MB (5/7/8)
    fragm 1*1 1*2 5*4 2*8 0*16 0*32 2*64 15*128 11*256 3*512 233*1024
  ZONE2 (Normal): size 1008MB, act 603MB, inact 258MB, free 2MB (1/2/2)
    fragm 1*1 9*2 3*4 3*8 2*16 1*32 2*64 1*128 1*256 2*512 1*1024
  Mem lat (ms): A0 0, K0 0, U0 0, K1 1, U1 0
  Slab pages: 243MB/243MB (ino 84MB, de 53MB, bh 49MB, pb 8MB)
Swap [ OK ]: tot 1992MB, free 1992MB, in 0.000MB/s, out 0.000MB/s
  Swap lat: si 0, 0/0 ms, so 0, 0/0 ms, 0/0 cpu ms
  Swap cache: add 0, del 0, find 0/0
Net [ OK ]: tot: in  0.002MB/s   22pkt/s, out  0.000MB/s    1pkt/s
             lo: in  0.000MB/s    0pkt/s, out  0.000MB/s    0pkt/s
           eth0: in  0.002MB/s   22pkt/s, out  0.000MB/s    1pkt/s
           eth1: in  0.000MB/s    0pkt/s, out  0.000MB/s    0pkt/s
           sit0: in  0.000MB/s    0pkt/s, out  0.000MB/s    0pkt/s
Disks [ OK ]: in 0.000MB/s, out 0.012MB/s
  root(/) free: 1964MB(50%), 972837ino(94%)
  vz(/vz) free: 174234MB(97%), 47117046ino(99%)
  sda1(/boot) free: 146MB(76%), 50155ino(99%)

  CTID ST    %VM     %KM        PROC    CPU     SOCK FCNT MLAT IP
     1 OK 3.0/-   0.2/-     0/78/256 0.0/100 42/1256    0    1 192.168.118.207
```

This screen will be updated with the time interval equal to the value specified after the `–d` (delay) option measured in seconds. In the session above, the statistics displayed will be renewed every five seconds. If the `–d` option is not specified, the default interval equals 1 second.

As you can see, the utility provides real-time information on the number of Containers and processes (in each and every state) on the Hardware Node, as well as on all the main resources subsystems pertaining both to the Hardware Node and to its Containers – the disk, network, CPU, and memory subsystems. You may want to shrink the output of the utility by specifying the `–b` (brief) option instead of the `–v` (verbose) one, or to do without any options to use the "normal" mode of displaying.

The following information is displayed per each Container:

Column Name	Description
`CTID`	Container ID.

`ST`	Container status. If there are no failed counters and the latency values are normal, the status is "OK". Otherwise, it is displayed in red as "!!". You can sort Containers by their status to see the problem Containers first.
`%VM`	Virtual memory usage (in per cent to the total memory), corresponding to the `privvmpages` parameter set in the Container configuration file. The first number is how much `privvmpages` are being held, and the second one is the `privvmpages` barrier.
`%KM`	Kernel memory usage (in per cent to the normal zone size), corresponding to the `kmemsize` parameter set in the Container configuration file. The first number is how much `kmemsize` is being used, and the second one is the `kmemsize` barrier.
`PROC`	Running/total/maximal processes number. The maximal number of processes represents the Container barrier. You can sort the Containers by the number of running or total processes.
`CPU`	CPU usage in per cent to all available CPUs. The first number is how much of the CPU power is being used by the Container, and the second one is its guaranteed share judging by the `cpuunits` parameter. Note that the actual CPU usage may be higher than the guaranteed one.
`SOCK`	Sockets usage, corresponding to the sum of the `numtcpsock` and `numothersock` parameters set in the Container configuration file. The first number is how many sockets are opened, the second one is the sockets barrier.
`FCNT`	The number of Container failed counters for all the resource parameters. In the standard mode of displaying, this number represents the increase of failed counters since the previous screen update, whereas in the average mode of displaying, it represents an absolute failed counters sum for the given Container.
`MLAT`	Maximal scheduling latency for the Container, in ms. This parameter shows the maximal scheduling latency inside the given Container, i.e. for how long (at the utmost) a process inside the Container awaits for the CPU.
`IP/HOSTNAME`	The IP address or the hostname of the given Container. You may switch between them by pressing the `e` key on the keyboard while `vzstat` is running.

The %VM, %KM, CPU, and SOCK columns provide two values per column separated by a slash for each Container. The first value indicates the real usage of the corresponding parameter by the Container, and the second one – the maximal value allowed for the Container. The PROC column shows the number of processes in the corresponding Container in the following format: running/total/maximal number of processes.

The great thing about the `vzstat` utility is its interactivity. You can set the time interval, manage the mode of displaying, sort the Containers by a number of parameters, and all this on-the-fly. For example:

1 While `vzstat` is running, press `t` on the keyboard, enter the new timeout (say, `180`), and press ENTER;
2 Press `b` to switch to the brief details level;
3 Press `w` to toggle the display of the swap information on the screen;
4 Press `o`, and then `r` to sort the displayed Containers by the number of running processes.

Now your screen must look something like the following:

```
  1:20pm, up 14 days, 19:17,  1 user, load average: 1.00, 1.00, 1.00
CTNum 1, procs  249: R   2, S  229, D   0, Z   0, T  18, X   0
CPU [ OK ]: CTs   0%, CT0  50%, user  30%, sys  20%, idle  50%, lat(ms)   3/0
Mem [CRIT]: total 3940MB, free 958MB/0MB (low/high), lat(ms) 1/0
Net [ OK ]: tot: in  0.001MB/s   16pkt/s, out  0.000MB/s    1pkt/s
Disks [ OK ]: in 0.000MB/s, out 0.000MB/s

  CTID ST    %VM     %KM         PROC    CPU     SOCK FCNT MLAT IP
     1 OK 3.0/-   0.2/-     0/78/256 0.0/100 42/1256    0    1 192.168.118.207
```

The `vzstat` utility has a configuration file where you can set the values of different parameters indicating the warning and/or the error levels for them. If a parameter hits the warning level, it will be displayed in yellow by the utility, if it hits the error level – in red. Moreover, if a parameter has hit the error level, the **CRIT** warning is displayed instead of **OK** after the name of the corresponding subsystem (CPU, Memory, Swap, Net, or Disks). Thus, for example, if you see `Swap [ CRIT ]` on the screen, it means that one or more of the Hardware Node swap-related parameters (the total size of swap memory used, the swap in/out activity, etc.) has hit the error level. The offending parameter(s) will be displayed in red.

Please consult Parallels Virtuozzo Containers Reference Guide for a complete list of command line options, interactive keys, and configuration file parameters of the `vzstat` utility.

Monitoring Resources in Parallels Management Console

You can exploit the **Monitor** feature of Parallels Management Console for monitoring resources. This feature provides either the whole Hardware Node resources monitoring or the monitoring of resources consumption by a single Container, depending on whether you use the Management Console main window or a particular Container manager window. To open the latter, it is enough to double-click the necessary Container in the Container table in the right pane of the Management Console main window. The principles of working with these two kinds of monitors are essentially the same (only the set of the parameters that can be displayed is slightly different); therefore, they can be described together. You can access the Management Console **Monitor** feature by selecting the **Monitor** item in the left pane of the window you are working with.

Using Charts Representation

The charts section of Parallels Management Console lets you display quite a number of charts for monitoring various kinds of resources on a single grid. It offers means for better visualization of charts, like assigning colors and line styles to all the elements of the grid and charts or choosing a peculiar representation scale for each chart. You can save and load a set of counters you would usually monitor thus avoiding the necessity of adding the counters one by one each time you start Management Console. And, last but not least, there is a possibility to replay the charts for any specified period of time by using logs.

The sequence of your actions may be the following:

1 To display the chart, expand the **Monitor** item in the window you are working with (either the Management Console main window or a Container manager window) and click **Charts** to see the monitor grid in the right pane.

2 Click the **Add Counters** button on the **Charts** toolbar.

3 In the **Add Monitoring Counters** dialog window, select the set of counters from which you want to add one(s) by selecting the desired group on the **Counter type** drop-down menu.

4 Select the needed counters and click **Add**. You may use the Ctrl and Shift keys to add a number of counters from a group. When you select a certain counter with your mouse, the counter description is provided in the lower part of the **Add Monitoring Counters** dialog window. For example:

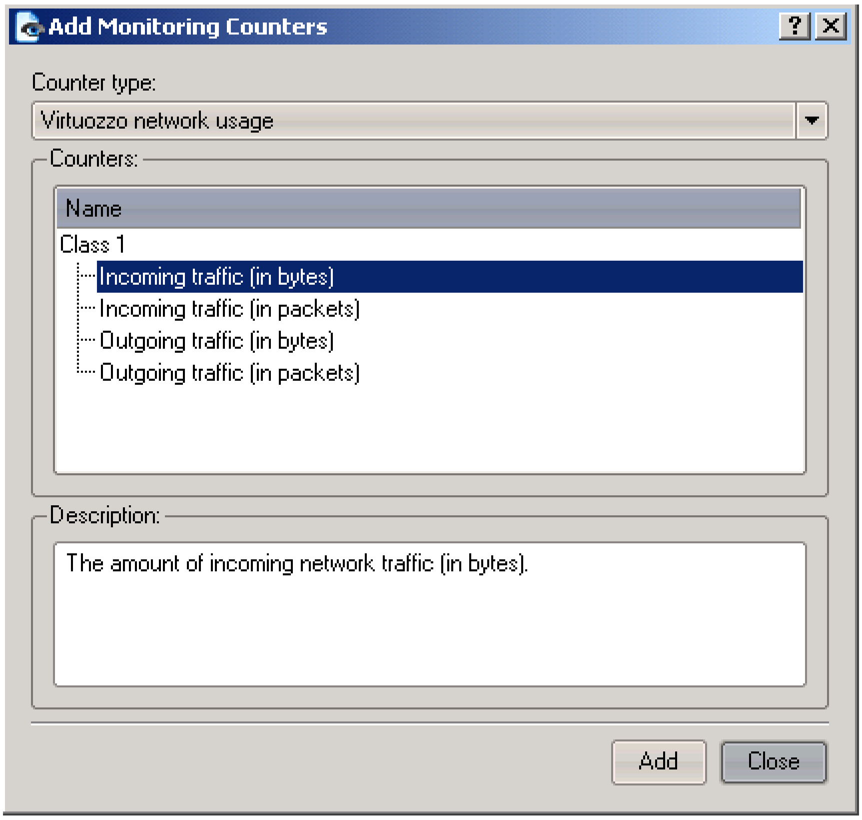

Figure 55: Management Console - Adding Monitoring Counters

5 Click **Close** after you have added all the desired counters.

Now that you have a number of counters on the grid, you can see a red line indicating the current moment of time moving from left to right as time passes and new values of monitored parameters appear on the grid. Now it's time to customize your view and learn the other opportunities. You may want to perform the following tasks:

- Adjust the periodicity of refreshing the information on the grid;
- Adjust the representation scale for each counter;
- Adjust colors and line styles for the visual elements;
- Highlight a certain counter;
- Save the current configuration of counters to be able to open it at any moment of time;
- Use the grid to replay some past real-time information about a set of parameters.

Adjusting Periodicity of Refreshing Information

To set the time interval at which the information is refreshed for all the charts, right-click the **Charts** item in the Hardware Node or Container main tree and choose one of the following options on the context menu:

- **Update Speed --> High**: choose this option to set the time interval to 1 second.
- **Update Speed --> Normal**: choose this option to set the time interval to 5 seconds.
- **Update Speed --> Low**: choose this option to set the time interval to 15 seconds.
- **Update Speed --> Pause**: choose this option to stop refreshing the information for the charts.

Adjusting Representation Scale

The value of any counter on the grid may vary from 0 to 100. These numbers are marked on the left of the grid. But the “weight” of these numbers is different for each counter. It is difficult to use one and the same scale, for example, for memory usage which may amount to hundreds of thousands of KBs and for CPU usage in percent. You can adjust the scale for each parameter separately for their better visualization on the grid:

1 Right-click the name of the corresponding counter in the table of displayed counters below the grid and select **Properties** on the context menu. For example:

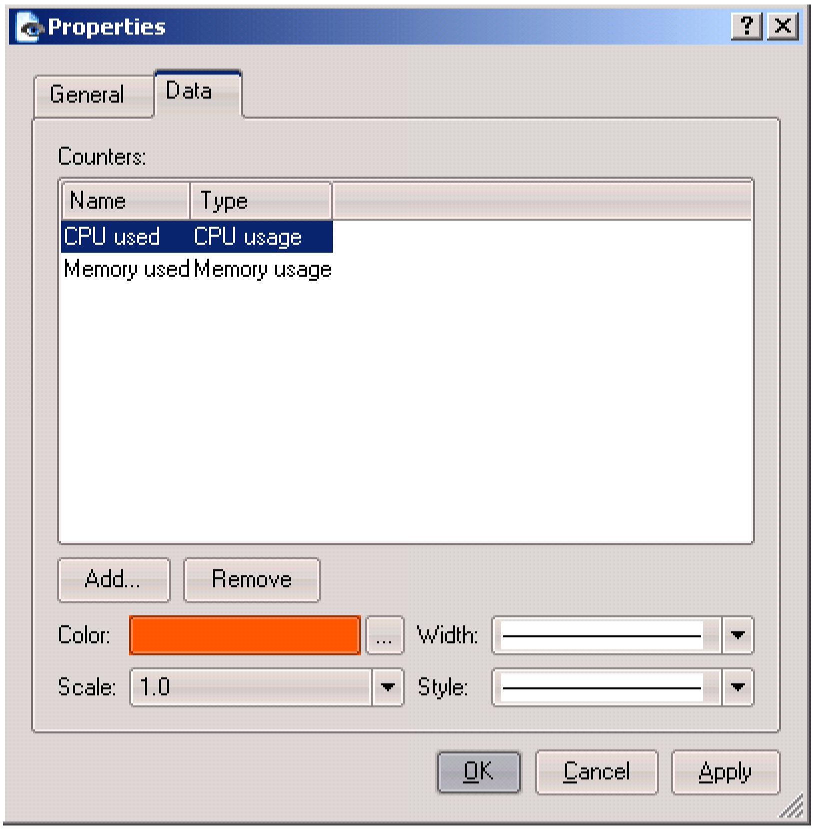

Figure 56: Management Console - Adjusting Charts Scale

2 Select the necessary scale on the **Scale** drop-down menu on top of the grid and click **Apply**.

Adjusting Colors and Styles

You can define the way this or that counter is displayed on the grid:

1 Right-click the name of the corresponding counter in the table of displayed counters below the grid and choose Properties:

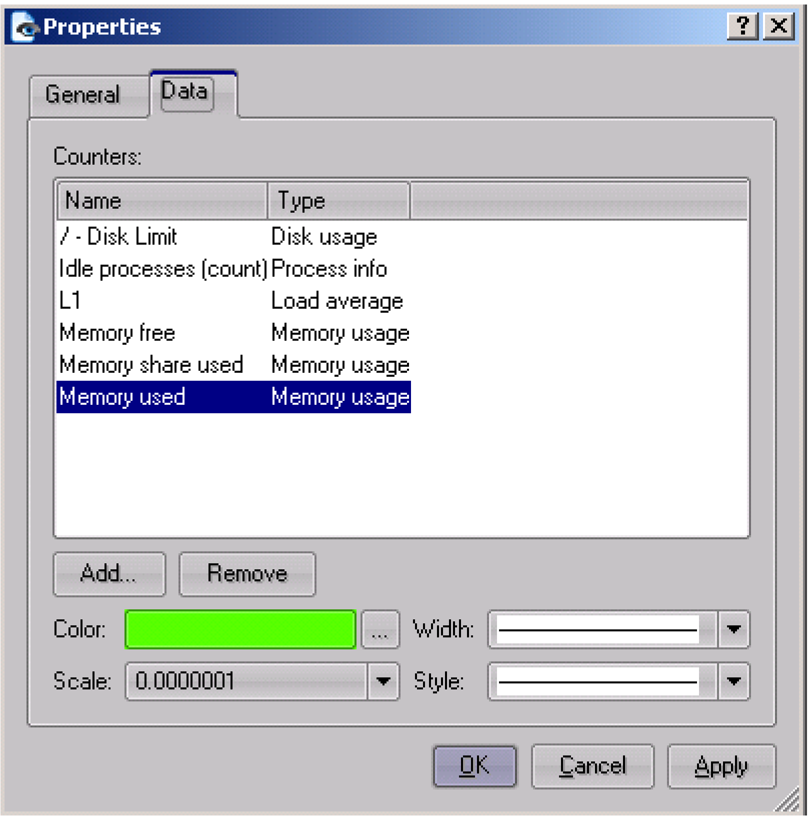

Figure 57: Management Console - Adjusting Charts View

2 In the corresponding boxes, adjust the color of the counter line, its width and style as desired.

3 Click the General tab and adjust the view of the grid elements. The options on that tab are self-explaining.

4 Click OK.

Highlighting Counter

In case there are many counters being simultaneously displayed on the grid, it might be difficult to quickly single out the needed one. Parallels Management Console provides a means for highlighting any one of the counters at a time:

1. Click the name of the corresponding counter in the table of displayed counters below the grid.
2. Click the **Highlight Counter** button on the toolbar.

The selected counter will be highlighted on the grid with a broad white line. For example:

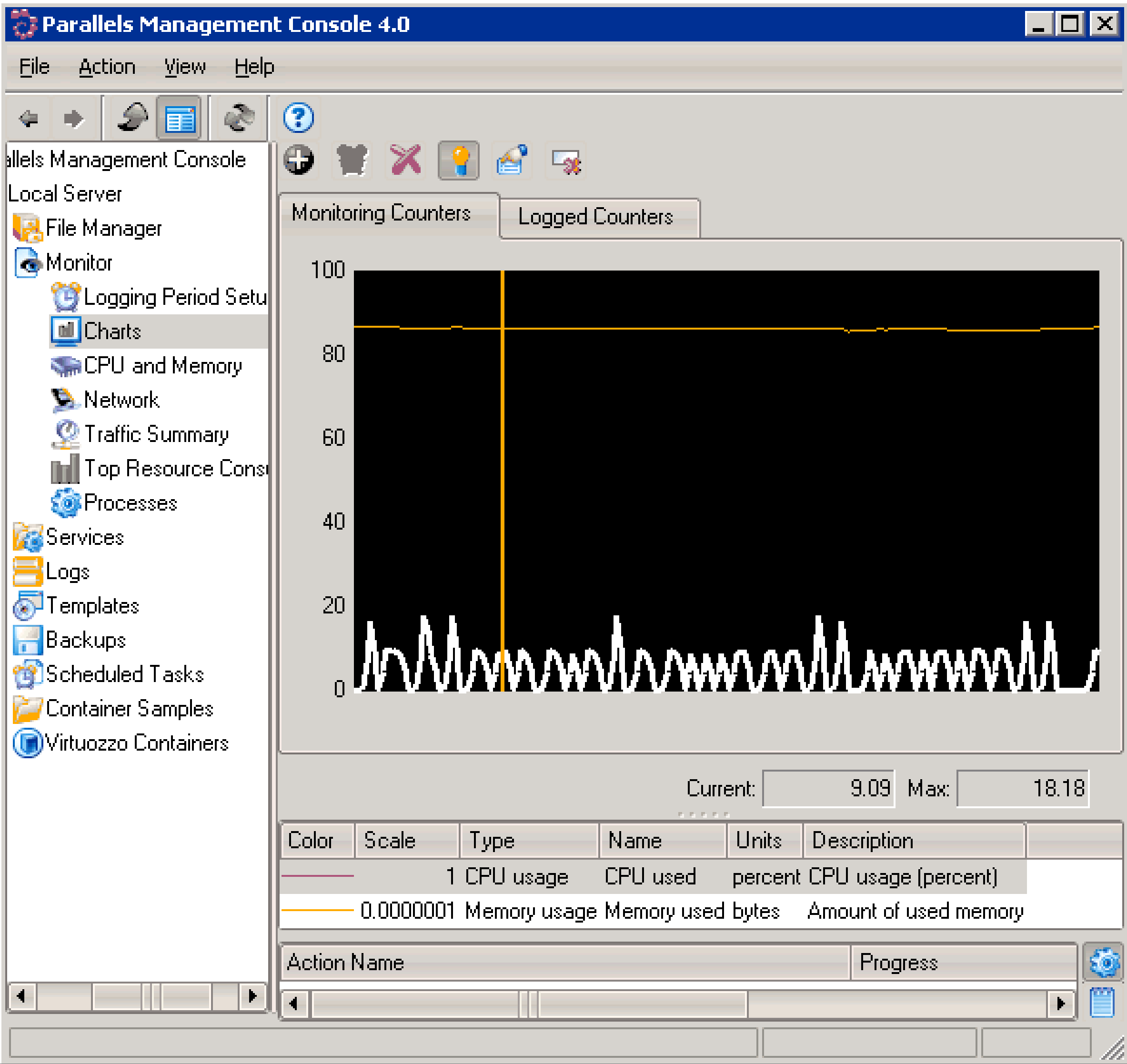

Figure 58: Management Console - Highlighting Counter

Saving Counters Configuration

You can save the information about the current set of counters in the Management Console configuration file to call this information the next time it is needed sparing the labor of adding the counters one by one again. Only one set of counters can thus be saved. Just right-click the counter you wist to save and select **Save Counters** on the context menu. When you alter the counters configuration (for example, when you restart Parallels Management Console, all the counters are erased) and wish to restore the saved configuration, click the **Load Counters** button. The saved set of counters will be loaded from the configuration file.

Replaying Information From Logs

The function of replaying the resources consumption information over a specified time span in the past is ensured by the background logging of all the parameters in Parallels Virtuozzo Containers 4.0. The default periodicity of refreshing the resources consumption information in the logs is set to be 1 (one) hour. You may have the logs collect the resources consumption information more frequently by "accelerating" the necessary logs with the help of the **Log Setup** folder under the **Monitor** item. For example:

1 Click **Logging Period Setup** under the **Monitor** item.

2 In the right of the Management Console window, double-click the necessary log group in the **Parameters** table, or right-click it and select **Properties** on the context menu.

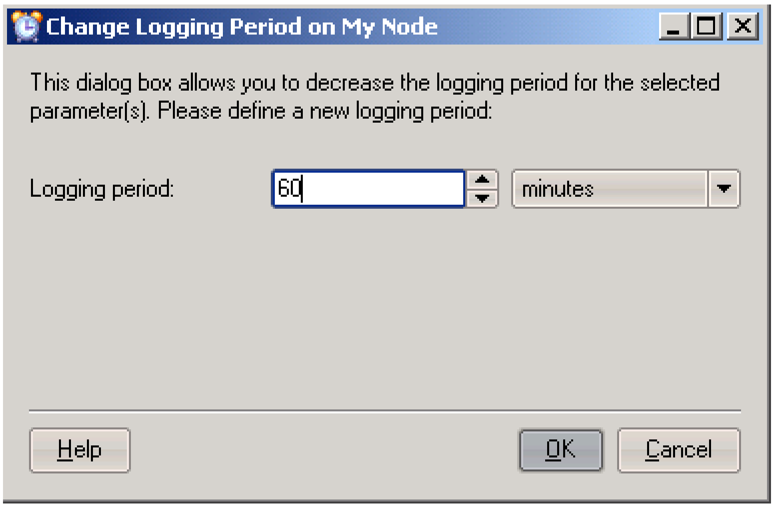

Figure 59: Management Console - Changing Logging Period

3 In the **Change Logging Period** window, set the update period for the given group of logs.

4 Click **OK** for the changes to take effect.

Note: Virtuozzo Management Console 3.x does not allow you to configure the periodicity of refreshing the resources consumption information in the logs for Hardware Nodes running Virtuozzo Containers 4.0.

The replaying proper of logs is performed using the same grid of the **Charts** function as for real-time monitoring. The counters are also displayed and configured in the same way as for real-time monitoring. The principal difference is that when replaying the counters, the information for the charts is taken from the logs (both the default logs and the logs accelerated in the **Logging Period Setup** section are used), and not from real-time monitoring.

To switch to the charts replaying mode:

1 Click **Charts** under the **Monitor** item.

2 On the **Logged Counters** tab, click the **Add Counters** button on the toolbar to display the **Add Logged Counters** window.

3 On the **Data** tab of the **Add Logged Counters** window, click the **Add** button to add any of the available counters in the same way as they are added for real-time monitoring.

4 After adding the desired counters, adjust the style of their visualization with the help of the corresponding options on the **Data** tab.

5 Go to the **Time** tab of the **Add Logged Counters** window, define the update period, and the time span for which you wish to view the logs for the specified counters. For example:

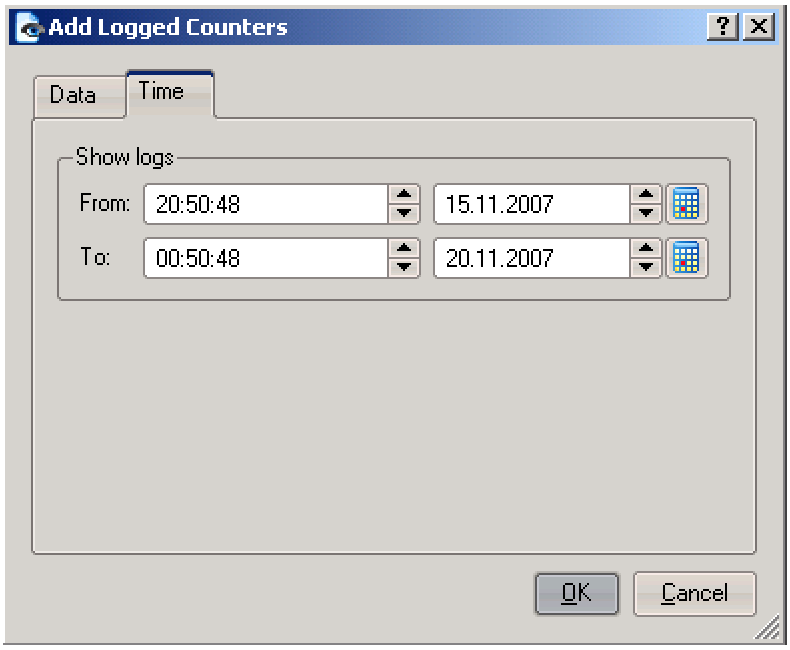

Figure 60: Management Console - Replaying Logs

Using Table Representation

Besides charts, it is possible to monitor many of the Hardware Node or Container parameters in real time as a list of lines each of which reflects the name and the value of a parameter, as well as the attributes specific for this or that kind of parameters. In such a way, you can view the Network and Processes groups for a particular Hardware Node, and the Network, Processes, Resources, and Quotas and Usage groups for a particular Container. Choose any of these groups either in the Management Console main window or in a Container manager window to see the real-time information about the selected parameters in the form of a table. For example, if you choose Network under a Hardware Node tree, you may see the following window:

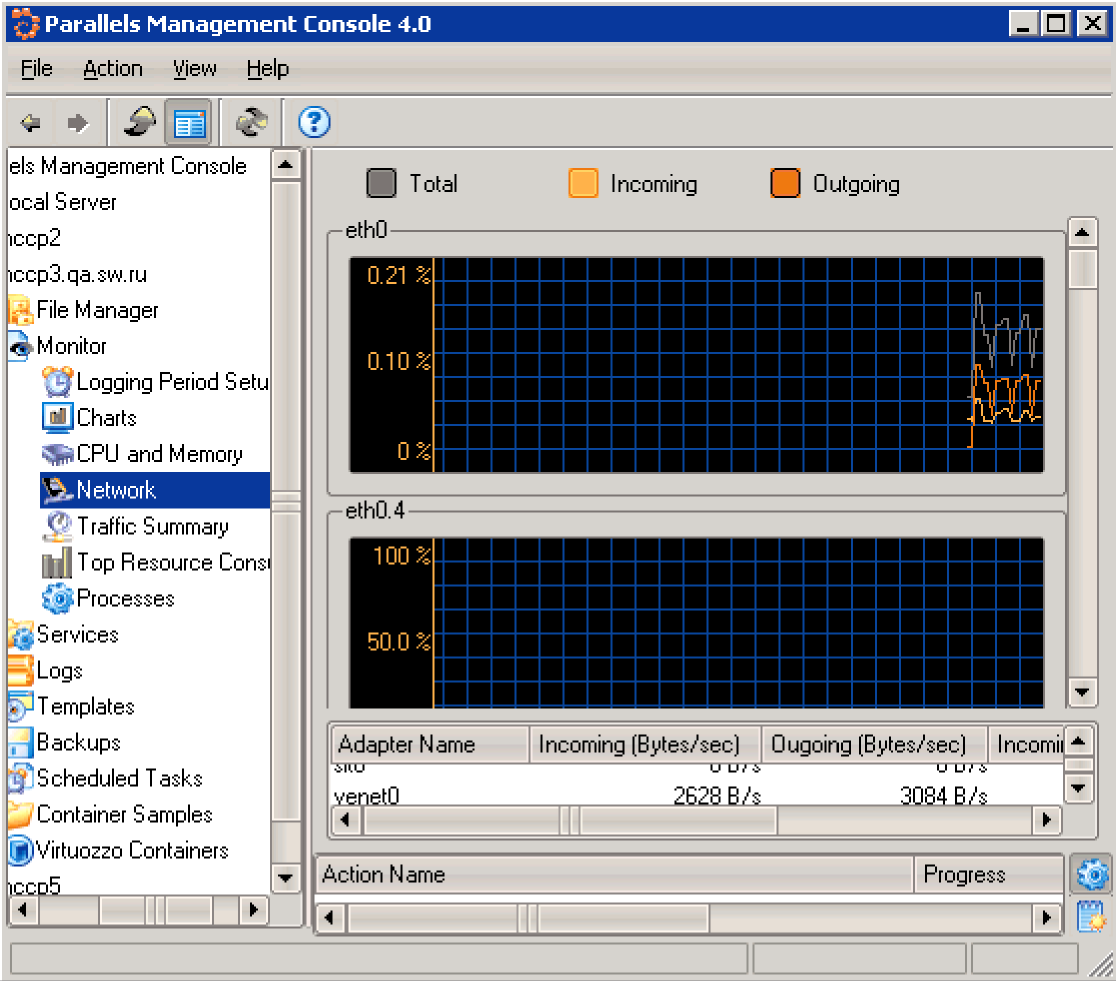

Figure 61: Management Console - Monitoring Traffic Parameters

The graphic chart in the Management Console right pane shows the values for the incoming and outcoming traffic rate in bytes per second and packets per second for all the network interfaces present on the Hardware Node.

Subscribing to Parallels Management Console Alerts

Parallels Management Console allows you to subscribe to e-mail notifications about resource-overusage system alerts. The subscription to this kind of alerts consists in specifying the e-mail address to send notification to. However, prior to subscribing to alerts, you should provide your e-mail relay server IP address to send e-mail notifications through. To this effect, do the following:

1 In Parallels Management Console, click the **Manage E-mail Alert Subscription** link on the Hardware Node dashboard.

2 In the **Manage E-mail Alert Subscription** window, click the **Configure** button:

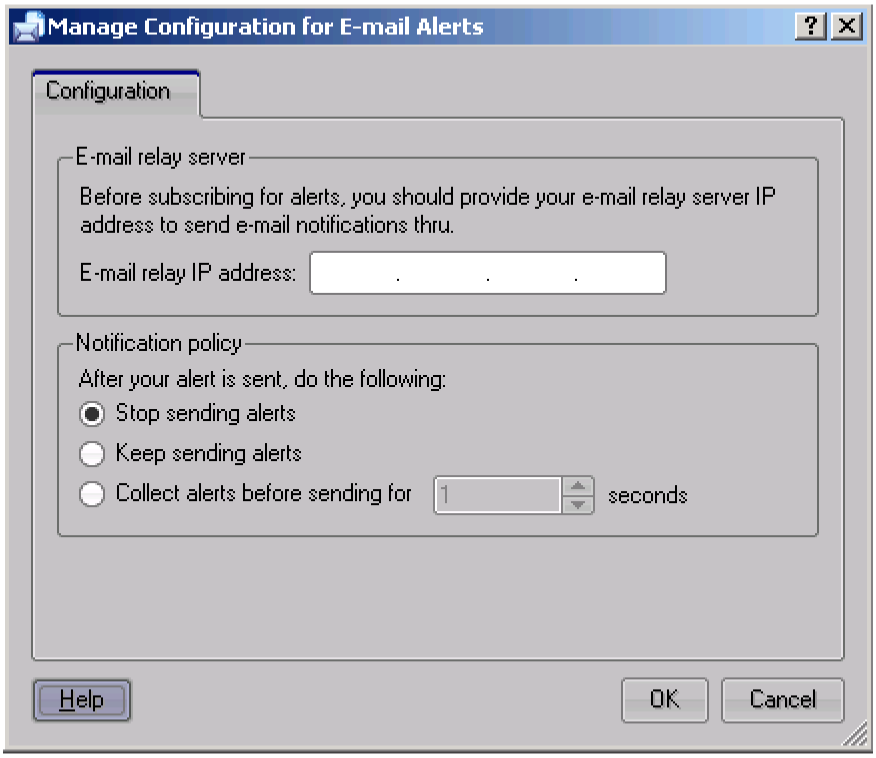

Figure 62: Management Console - Setting E-mail Relay Server

3 In the displayed window, enter the IP address of the mail relay server in the **E-mail relay IP address** field:

4 Click **OK**.

Now that you have set the e-mail relay server IP address, you can subscribe to an alert:

1 Click the **Manage E-mail Alert Subscription** link on the Hardware Node dashboard:

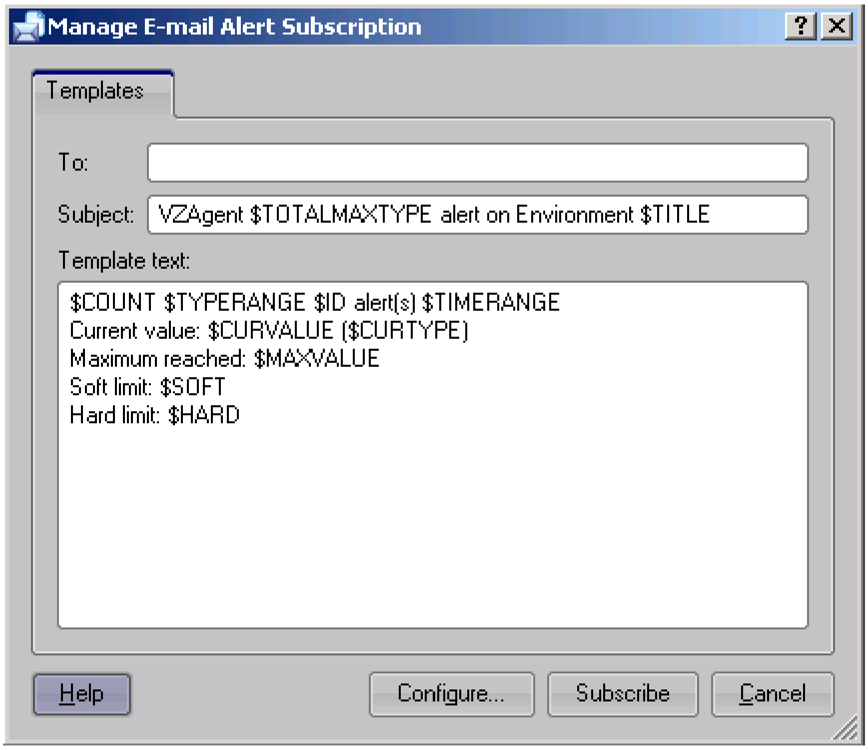

Figure 63: Management Console - Subscribing to Alert

2 Type the e-mail address where the alert notification is to be sent in the **To** field.

3 Click the **Subscribe** button.

Parallels Management Console uses a pre-configured notification template. This template includes special placeholders representing special symbols that will be substituted for in the actual message by the actual Container name, parameter name, etc. A list of the main placeholders is given below:

- `$TITLE`: the name assigned to the Container. If there is no name set for the Container, its hostname is used;
- `$ID`: the name of the resource parameter (in the actual message, it will be "diskspace", etc.);
- `$CURTYPE`: the alert type (at the alert generation moment). The "yellow" alert means that the barrier value lies in the range from 90% to 100% and the "red" alert indicates that the limit value has been hit;
- `$TOTALMAXTYPE`: the maximal alert type ("yellow" or "red") registered during the time when alerts were collected;
- `$COUNT`: the number of registered alerts from the time when the last e-mail notification was sent;
- `$TYPERANGE`: the range of alert types registered during the time when alerts were collected (e.g. if all types of alerts were registered, the value of this parameter in the e-mail notification will be set to "yellow" or "red");
- `$TIMERANGE`: the alert time (the server time);
- `$CURVALUE`: the current value of the parameter (at the alert generation moment);
- `$MAXVALUE`: the maximal value of the parameter during the time when alerts were collected;

- `$SOFT`: the parameter value barrier;
- `$HARD`: the parameter value limit.

By default, only one alert is sent per subscription and you have to resubscribe to an alert each time after its receiving. However, you can configure the default alert policy by doing the following:

1. Click the **Manage E-mail Alert Subscription** link on the Hardware Node dashboard.
2. In the **Manage E-mail Alert Subscription** window, click the **Configure** button.
3. In the displayed window, you can choose one of the following options:
   - **Stop sending alerts**. In this case after having received an alert, you have to resubscribe to it again. This option is selected by default.
   - **Keep sending alerts.** In this case you will get alerts on a permanent basis without having to resubscribe to them each time after their receiving.
   - **Collect alerts before sending for...** In this case alerts will be permanently collected by the Parallels Agent software to a special database. This database will be periodically, i.e. with the period specified in the field opposite the option name, checked and if there were any alerts gathered during the set time, the corresponding notification will be sent to your e-mail address. The alert checking time is measured in seconds and can be set either by using the spin button or entering the needed period by hand.
4. After you have chosen the right option, click **OK** to save the settings.

Monitoring Virtuozzo Objects Using vzsnmp Plug-in

This section provides information on how you can monitor Parallels Virtuozzo objects using the `vzsnmp` plug-in.

Understanding vzsnmp Basics

Starting with version 4.0, Parallels Virtuozzo Containers is provided with the `vzsnmp` application allowing you to monitor network and system resources on the Hardware Node and inside its Containers by means of the SNMP (Simple Network Management Protocol) protocol. The `vzsnmp` application includes two components - `vzsnmp` and `vzsnmp-proxy` - which are automatically installed on the Hardware Node (`vzsnmp-proxy`) and inside the Service Container (`vzsnmp`) during the Virtuozzo Containers 4.0 installation.

The `vzsnmp` plug-in conforms to the same SMI (Structure of Management Information) rules as the data represented within the standard context of SNMP, for example:

- all Virtuozzo objects are organized into a tree-like hierarchy
- any object is made up of a series of integers corresponding to the nodes in the tree and separated by dots.

The `root` subtree containing all Virtuozzo-related objects has the object ID of `1.3.6.1.4.1.26171.1.1` and is described in the `/usr/share/snmp/mibs/SWSOFT-SMI.txt` file inside the Service Container.

The `vzsnmp` plug-in enables you to monitor a number of objects and their states in respect of the Hardware Node and its Containers (e.g. the version of Parallels Virtuozzo currently installed on your Node or the IP addresses assigned to your Containers). All the data that can be reported by the `vzsnmp` application is described in detail in the following subsection.

Using SNMP Management Tools to Monitor Parallels Virtuozzo Objects

When working with SNMP in Parallels Virtuozzo-based systems, please keep in mind that Parallels Virtuozzo 4.0 does not maintain control over the SNMP service. You can use standard SNMP management tools to administer this service and gather the information on Parallels Virtuozzo-related objects.

The following example demonstrates how you can use the `snmpwalk` Linux utility to get the status of Parallels Virtuozzo objects. For the sake of simplicity, we assume in our example that your Hardware Node hosts only the Service Container which is treated by the `vzsnmp` plug-in as any other regular Container. To obtain the information on Virtuozzo-related objects, you should do the following:

1. Install the `net-snmp` and `net-snmp-utils` packages on the Node.

Note: By default, the SNMP service is not installed on the Hardware Node during the Virtuozzo Containers 4.0 installation. So, you should install the `net-snmp` and `net-snmp-utils` packages on your Node manually.

2 Make sure that the `snmpd` daemon is running on the Hardware Node. If it is not, start the service:

```
# service snmpd start
Starting snmpd:           [OK]
```

3 Ascertain that the `snmpd` daemon is running inside the Service Container. If it is not, start the service by executing the following commands on the Node:

```
# vzctl enter 1
entered into Container 1
-bash-2.05b# service snmpd start
Starting snmpd:           [OK]
```

4 On the computer that is to server as the Monitor Node, run the `snmpwalk` utility to collect the information on Parallels Virtuozzo-related objects available on your Hardware Node. For example, you can do this by running the following command:

```
# snmpwalk -m SWSOFT-VIRTUOZZO-MIB -v 1 -c public 10.30.20.207
\.1.3.6.1.4.1.26171.1.1
```

where

- `-m` specifies which MIB module should be loaded by the command. The Parallels Virtuozzo MIB module has the name of `SWSOFT-VIRTUOZZO-MIB`; so, we indicated this name after the `-m` option.
- `-v 1` specifies which version of SNMP to use.
- `-c` specifies the community string for the command. The default community string to access the Parallels Virtuozzo MIB is `public`.
- `10.30.20.207` denotes in our example the IP address of the Hardware Node where you want to monitor Parallels Virtuozzo objects.
- `.1.3.6.1.4.1.26171.1.1` is the path to the root subtree containing the Parallels Virtuozzo-related objects.

When executed, `snmpwalk` walks the entire Parallels Virtuozzo subtree and displays the information on all Parallels Virtuozzo-related objects (the Container IP addresses, the OS template the Container is based on, etc.) which can be monitored. A typical `snmpwalk` command output is given below:

```
SWSOFT-VIRTUOZZO-MIB::vzHWID.0 = STRING: "a87f51dd-4e1e-4c44-a282-
8a7843ca183f"
SWSOFT-VIRTUOZZO-MIB::vzVersion.0 = STRING: 4.0.0
SWSOFT-VIRTUOZZO-MIB::vzLicenseStatus.0 = STRING: ACTIVE
SWSOFT-VIRTUOZZO-MIB::vzEnvID.1 = Gauge32: 1
SWSOFT-VIRTUOZZO-MIB::vzEnvEid.1 = STRING: "0ad47247-3b48-d847-877e-
9613584f4b8c"
SWSOFT-VIRTUOZZO-MIB::vzEnvType.1 = STRING: Virtuozzo
SWSOFT-VIRTUOZZO-MIB::vzEnvName.1 = STRING: ServiceCT
SWSOFT-VIRTUOZZO-MIB::vzEnvDescription.1 = STRING:
SWSOFT-VIRTUOZZO-MIB::vzEnvOS.1 = STRING: redhat-as3-minimal/20061020
SWSOFT-VIRTUOZZO-MIB::vzEnvOrigSample.1 = STRING: "00000000-0000-0000-0000-
000000000000"
SWSOFT-VIRTUOZZO-MIB::vzEnvState.1 = INTEGER: running(6)
SWSOFT-VIRTUOZZO-MIB::vzEnvTransition.1 = INTEGER: none(0)
SWSOFT-VIRTUOZZO-MIB::ipAddrEntAddress.1.10.224.182.173 = IpAddress:
10.224.182.173
SWSOFT-VIRTUOZZO-MIB::ipAddrEntNetMask.1.10.224.182.173 = IpAddress:
255.255.255.255
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskSpace.1 = Gauge32: 517340
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskSpaceSoft.1 = Gauge32: 11141120
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskSpaceHard.1 = Gauge32: 10485760
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskInodes.1 = Gauge32: 26728
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskInodesSoft.1 = Gauge32: 400000
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskInodesHard.1 = Gauge32: 440000
SWSOFT-VIRTUOZZO-MIB::envQuotaUgid.1 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envQuotaUgidHard.1 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetworkClass.1.0 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetworkClass.1.1 = Gauge32: 1
SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingBytes.1.0 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingBytes.1.1 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingPackets.1.0 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingPackets.1.1 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingBytes.1.0 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingBytes.1.1 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingPackets.1.0 = Gauge32: 0
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingPackets.1.1 = Gauge32: 0
End of MIB
```

The information provided by the `snmpwalk` utility is explained in the table below:

Line	Description
SWSOFT-VIRTUOZZO-MIB::vzHWID.0 = STRING: "a87f51dd-4e1e-4c44-a282-8a7843ca183f"	The Hardware Node unique identifier used by Virtuozzo tools (Parallels Infrastructure Manager and Parallels Management Console) to identify the Hardware Node.
SWSOFT-VIRTUOZZO-MIB::vzVersion.0 = STRING: 4.0.0	The version of Parallels Virtuozzo Containers currently installed on the Hardware Node.
SWSOFT-VIRTUOZZO-MIB::vzLicenseStatus.0 = STRING: ACTIVE	The status of the Parallels Virtuozzo Containers license.
SWSOFT-VIRTUOZZO-MIB::vzEnvID.1 = Gauge32: 1	The ID of the Container. (The Service Container is always marked as Container 1.)

SWSOFT-VIRTUOZZO-MIB::vzEnvEid.1 = STRING: "0ad47247-3b48-d847-877e-9613584f4b8c"	The Container unique identifier used by Virtuozzo tools to identify the Container.
SWSOFT-VIRTUOZZO-MIB::vzEnvType.1 = STRING: Virtuozzo	The virtualization technology of the Container.
SWSOFT-VIRTUOZZO-MIB::vzEnvName.1 = STRING: ServiceCT	The hostname of the Container.
SWSOFT-VIRTUOZZO-MIB::vzEnvDescription.1 = STRING:	The description of the Container, if set.
SWSOFT-VIRTUOZZO-MIB::vzEnvOS.1 = STRING: redhat-as3-minimal/20061020	The name of the OS template the Container is based on.
SWSOFT-VIRTUOZZO-MIB::vzEnvOrigSample.1 = STRING: "00000000-0000-0000-0000-000000000000"	The Container original sample unique identifier used by Virtuozzo tools to identify the Container sample.
SWSOFT-VIRTUOZZO-MIB::vzEnvState.1 = INTEGER: running(6)	The current state of the Container.
SWSOFT-VIRTUOZZO-MIB::vzEnvTransition.1 = INTEGER: none(0)	The transitional state of the Container.
SWSOFT-VIRTUOZZO-MIB::ipAddrEntAddress.1.10.224.182.173 = IpAddress: 10.224.182.173	The IP address assigned to the Container.
SWSOFT-VIRTUOZZO-MIB::ipAddrEntNetMask.1.10.224.182.173 = IpAddress: 255.255.255.255	The network mask assigned to the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskSpace.1 = Gauge32: 517340	The disk space currently consumed by the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskSpaceSoft.1 = Gauge32: 10485760	The disk space soft limit set for the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskSpaceHard.1 = Gauge32: 11141120	The disk space hard limit set for the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskInodes.1 = Gauge32: 26728	The number of disk inodes (files, directories, symbolic links) currently used by the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskInodesSoft.1 = Gauge32: 400000	The disk inodes soft limit set for the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaDiskInodesHard.1 = Gauge32: 440000	The disk inodes hard limit set for the Container.
SWSOFT-VIRTUOZZO-MIB::envQuotaUgid.1 = Gauge32: 0 SWSOFT-VIRTUOZZO-MIB::envQuotaUgidHard.1 = Gauge32: 0	The number of user/group IDs allowed for the Container internal disk quota. (This parameter is disabled for the Service Container.)
SWSOFT-VIRTUOZZO-MIB::envNetworkClass.1.0 = Gauge32: 0 SWSOFT-VIRTUOZZO-MIB::envNetworkClass.1.1 = Gauge32: 1	The network classes currently existing on the Hardware Node.
SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingBytes.1.0 = Gauge32: 0 SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingBytes.1.1 = Gauge32: 0	The amount of incoming traffic, in bytes, consumed by the Container.

SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingPackets.1.0 = Gauge32: 0	The amount of incoming traffic, in packets, consumed by the Container.
SWSOFT-VIRTUOZZO-MIB::envNetstatIncomingPackets.1.1 = Gauge32: 0	
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingBytes.1.0 = Gauge32: 0	The amount of outcoming traffic, in bytes, consumed by the Container.
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingBytes.1.1 = Gauge32: 0	
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingPackets.1.0 = Gauge32: 0	The amount of outcoming traffic, in packets, consumed by the Container.
SWSOFT-VIRTUOZZO-MIB::envNetstatOutgoingPackets.1.1 = Gauge32: 0	

The `snmp` plug-in also reports the information about the names and versions of the application templates applied to your Containers. However, this information is not shown for the Service Container; so, it is absent from the `snmpwalk` command output above.

To discover the full power of the `vzsnmp` plug-in and to have a total network view of your Parallels Virtuozzo Hardware Nodes, you can make use of NMS (Network Management Stations) suites uniting multiple applications into one convenient product. Examples of such suites are HP OpenView NNM, Tivoli Netview, Castle Rock SNMPc, etc.

CHAPTER 6

Managing Services and Processes

This chapter provides information on what services and processes are, the influence they have on the operation and performance of your system, and the tasks they perform in the system.

You will learn how to use the command line utilities and Parallels Management Console in order to manage services and processes in Virtuozzo Containers 4.0. In particular, you will get to know how you can monitor active processes in your system, change the mode of the `xinetd`-dependent services, identify the Container ID where a process is running by the process ID, start, stop, or restart services and processes, and edit the service run levels.

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What Are Services and Processes

Instances of any programs currently running in the system are referred to as processes. A process can be regarded as the virtual address space and the control information necessary for the execution of a program. A typical example of a process is the *vi* program (on a Linux Node) running on your Hardware Node or inside your Container(s). Along with common processes, there are a great number of processes that provide an interface for other processes to call. They are called services. In many cases, services act as the brains behind many crucial system processes; they typically spend most of their time waiting for an event to occur or for a period when they are scheduled to perform some task. Many services provide the possibility for other servers on the network to connect to the given one via various network protocols.For example, the `nfs` service provides the NFS server functionality allowing file sharing in TCP/IP networks.

You may also come across the term "daemon" that is widely used in connection with processes and services. This term refers to a software program used for performing a specific function on the server system and is usually used as a synonym for "service". It can be easily identified by "d" at the end of its name. For example, `httpd` (short for HTTP daemon) represents a software program that runs in the background of your system and waits for incoming requests to a web server. The daemon answers the requests automatically and serves the hypertext and multimedia documents over the Internet using HTTP.

When working with services, you should keep in mind the following. During the lifetime of a service, it uses many system resources. It uses the CPUs in the system to run its instructions and the system's physical memory to hold itself and its data. It opens and uses files within the filesystems and may directly or indirectly use certain physical devices in the system. Therefore, in order not to damage your system performance you should run only those services on the Hardware Node that are really needed at the moment.

Besides, you should always remember that running services in the Host OS is much more dangerous than running them in Containers. In case violators get access to one of the Containers through any running service, they will be able to damage only the Container where this service is running, but not the other Containers on your Hardware Node. The Hardware Node itself will also remain unhurt. And if the service were running on the Hardware Node it would damage both the Hardware Node and all the Containers residing on it. Thus, you should make sure that you run only those services on the Hardware Node that are really necessary for its proper functioning. Please launch all additional services you need at the moment inside separate Containers. It will significantly improve your system safety.

Notes: 1. In Parallels Management Console, you can view all available services by clicking on the **Services** folder item in the tree below the Hardware Node name or the Container name or clicking on the **Manage Unix Services** link on the corresponding summary page.

2. When working with the command line, you can use the `vzps` or `vztop` utilities to display all the processes that are currently running in your system.

Main Operations on Services and Processes

The ability to monitor and control processes and services in your Virtuozzo system is essential because of the profound influence they have on the operation and performance of your whole system. The more you know about what each process or service is up to, the easier it will be to pinpoint and solve problems when they creep in.

The most common tasks associated with managing services in the Host Operating System of the Hardware Node or inside a Container are starting, stopping, enabling, and disabling a service. For example, you might need to start a service in order to use certain server-based applications, or you might need to stop or pause a service in order to perform testing or to troubleshoot a problem.

For `xinetd`-dependent services, you do not start and stop but enable and disable services. The services enabled in this way are started and stopped on the basis of the corresponding state of the `xinetd` daemon. Disabled services are not started whatever the `xinetd` state.

The services management is mostly disabled for the Hardware Node. Practically all the services are read-only, you are able to view the information but you cannot perform any operation on them. The reason is that many Red Hat packages determine a successful stop by looking up all the processes with a specified name. If such processes exist elsewhere, they are killed with the terminate signal. Thus, all the like services in all the Hardware Node Containers might be accidentally shut down because of this.

However, there are some services that can be managed by a number of administrative tools offered in Parallels Virtuozzo Containers. These tools allow a service to be managed and configured either by means of special Linux command-line utilities or via Parallels Management Console. You can do it either locally or from any server connected on the network. Besides, you can manage all the processes and services through Parallels Power Panel. All the necessary information on managing services and operations in Parallels Power Panel is provided in the comprehensive online help system and the user's manual Parallels Power Panel is supplied with.

As for processes, such utilities as `vzps`, `vztop`, `vzpid` enable you to see what a process is doing and to control it. Sometimes, your system may experience problems such as slowness or instability, and using these utilities should help you improve your ability to track down the causes. It goes without saying that in Parallels Virtuozzo Containers you can perform all those operations on processes you can do in the common Linux system, for example, kill a process by sending a terminate signal to it.

In Virtuozzo Containers 4.0, you can manage services and processes using both the command line and Parallels Management Console. Further in this chapter, both methods are described.

Managing Processes and Services

In Virtuozzo Containers 4.0, services and processes can be managed by using both the command line and Parallels Management Console. In the command line, you can manage the corresponding processes and services by using the following utilities:

- `vzps`,
- `vzpid`,
- `vztop`, and
- `vzsetxinetd`.

With their help you can perform the following tasks:

- Print information about active processes on your Hardware Node;
- Display the processes activity in real time;
- Change the mode of the services that can be either `xinetd`-dependent or standalone;
- Identify the Container ID where a process is running by the process ID.

Parallels Management Console allows you to manage the services present in the Host Operating System of the Hardware Node or in a Container. It allows you to monitor (and partially configure) the services of the Host operating system at the Hardware Node. By using Management Console, you can start, stop, restart a service, or edit its run levels.Below in this chapter detailed information on all those tasks that can be performed by means of the command line utilities and Parallels Management Console is given.

Viewing Active Processes and Services

The vzps utility can be run on the Hardware Node just as the standard Linux ps utility. It provides certain additional functionality related to monitoring separate Containers running on the Node, namely, you can use the -E switch with the vzps utility to:

- display the Container IDs where the processes are running;
- view the processes running inside a particular Container.

vzps prints information about active processes on your Hardware Node. When run without any options, vzps lists only those processes that are running on the current terminal. Below is an example output of the vzps run:

```
$ vzps
  PID TTY          TIME CMD
 4684 pts/1    00:00:00 bash
27107 pts/1    00:00:00 vzps
```

Currently, the only processes assigned to the user/terminal are the bash shell and the vzps command itself. In the output, the PID (Process ID), TTY, TIME, and CMD fields are contained. TTY denotes which terminal the process is running on, TIME shows how much CPU time the process has used, and CMD is the name of the command that started the process.

Note: Starting with Virtuozzo Containers 3.0, the IDs of the processes running inside Containers and displayed by running the vzps command on the Hardware Node does not coincide with the IDs of the same processes shown by running the ps command inside these Containers.

As you can see, the standard vzps command just lists the basics. To get more details about the processes running on your Hardware Node, you will need to pass some command line arguments to vzps. For example, using the aux arguments with this command displays processes started by other users (a), processes with no terminal or one different from yours (x), the user who started the process and when it began (u). Besides, you can pass vzps the -E switch, which is specific for Parallels Virtuozzo Containers, to sort the processes by the Container IDs where they are running.

```
# vzps aux -E
USER  PID %CPU %MEM   VSZ  RSS TTY   STAT START  TIME COMMAND
root    1  0.0  0.0  1516  128 ?     S   Jul14   0:37 init
root    5  0.0  0.0     0    0 ?     S   Jul14   0:03 [ubstatd]
root    6  0.0  0.0     0    0 ?     S   Jul14   3:20 [kswapd]
#27     7  0.0  0.0     0    0 ?     S   Jul14   0:00 [bdflush]
root    9  0.0  0.0     0    0 ?     S   Jul14   0:00 [kinoded]
root 1574  0.0  0.1   218  140 pts/4 S   09:30   0:00 -bash
```

There is a lot more information now. The fields USER, %CPU, %MEM, VSZ, RSS, STAT, and START have been added. Let us take a quick look at what they tell us.

The USER field shows you which user initiated the command. Many processes begin at system start time and often list root or some system account as the USER. Other processes are, of course, run by individuals.

The %CPU, %MEM, VSZ, and RSS fields all deal with system resources. First, you can see what percentage of the CPU the process is currently utilizing. Along with CPU utilization, you can see the current memory utilization and its VSZ (virtual memory size) and RSS (resident set size). VSZ is the amount of memory the program would take up if it were all in memory; RSS is the actual amount currently in memory. Knowing how much a process is currently eating will help determine if it is acting normally or has spun out of control.

You will notice a question mark in most of the TTY fields in the `vzps aux` output. This is because most of these programs were started at boot time and/or by initialization scripts. The controlling terminal does not exist for these processes; thus, the question mark. On the other hand, the `bash` command has a TTY value of pts/4. This is a command being run from a remote connection and has a terminal associated with it. This information is helpful for you when you have more than one connection open to the machine and want to determine which window a command is running in.

STAT shows the current status of a process. In our example, many are sleeping, indicated by an S in the STAT field. This simply means that they are waiting for something. It could be user input or the availability of system resources. The other most common status is R, meaning that it is currently running.

Note: For detailed information on all `vzps` parameters, output fields, states of processes, etc., please consult the `vzps` manual pages.

In the current version of Parallels Virtuozzo Containers, you can also use the `vzps` command to view the processes currently running inside any Containers on the Hardware Node. The example below shows you how to display all active processes inside Container 101:

```
# vzps -E 101
CTID   PID TTY          TIME CMD
101 27173 ?        00:00:01 init
101 27545 ?        00:00:00 syslogd
101 27555 ?        00:00:00 sshd
101 27565 ?        00:00:00 xinetd
101 27576 ?        00:00:03 httpd
101 27583 ?        00:00:00 httpd
101 27584 ?        00:00:00 httpd
101 27587 ?        00:00:00 crond
101 27596 ?        00:00:00 saslauthd
```

In its turn, Parallels Management Console allows you to monitor the services present in the Host Operating System of the Hardware Node or inside a Container. Click on the **Services** item in the tree below the Hardware Node name. A list of the Host OS or Container OS services should appear in the right pane:

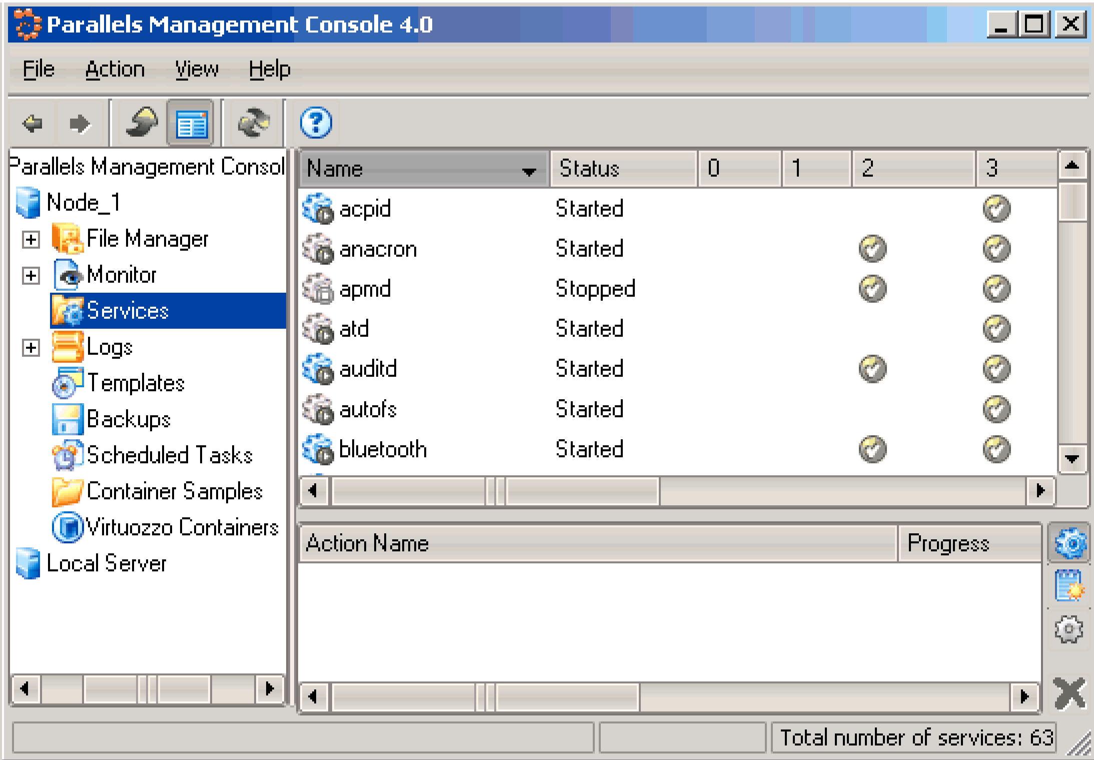

Figure 64: Management Console - Viewing Services

The way the services are colored reflects the importance of a service for Parallels Virtuozzo Containers: pink icons are for services that are critical for Parallels Virtuozzo Containers and yellow icons are for services that are not that critical.

Running services are indicated with bright icons. Stopped services have shaded icons. The Status column of the table duplicates this information in the text form. The default run levels of services are ticked off in the corresponding table columns.

To facilitate working with services, you can sort them by different parameters: their name, status, etc. Just click the column with the appropriate name to put services in the desired order.

Monitoring Processes in Real Time

The vztop utility is rather similar to vzps but is usually started full-screen and updates continuously with process information. This can help with programs that may infrequently cause problems and can be hard to see with vzps. Overall system information is also presented, which makes a nice place to start looking for problems.

The vztop utility can be run on the Hardware Node just as the standard Linux top utility. The only features that distinguish the vztop utility from top are the following:

- vztop allows you to use the -E option that monitors only the processes belonging to the Container whose processes you wish to display;
- you can use the e interactive command to temporarily view/hide the CTIDs where the processes are running;
- you can use the E interactive command to set the filter on the CTID field that helps you display only the processes belonging to the given Container.

The vztop utility usually has an output like the following:

```
# vztop -E 101
17:54:03  up 20 days, 23:37, 4 users, load average: 2.13, 1.89, 1.75
305 processes: 299 sleeping, 3 running, 3 zombie, 0 stopped
CPU0 states: 20.1% user 51.2% system  0.0% nice 0.0% iowait 28.1% idle
CPU1 states: 21.2% user 50.0% system  0.0% nice 0.0% iowait 28.1% idle
Mem: 1031088k av, 969340k used, 61748k free, 0k shrd, 256516k buff
       509264k active,            330948k inactive
Swap: 4056360k av,   17156k used, 4039204k free      192292k cached
CTID   PID USER PR  NI  VIRT  RES  SHR S %CPU %MEM  TIME+  COMMAND
101  27173 root 16  0   1616  604 1420 S  0.0  0.1  0:01.86 init
101  27545 root 16  0   1520  624 1356 S  0.0  0.1  0:00.34 syslogd
101  27555 root 25  0   4008 1700 3632 S  0.0  0.4  0:00.04 sshd
101  27565 root 25  0   2068  860 1740 S  0.0  0.2  0:00.05 xinetd
101  27576 root 16  0   7560 3180 6332 S  0.0  0.7  0:03.78 httpd
101  27587 root 16  0   2452 1036 1528 S  0.0  0.2  0:00.34 crond
101  27596 root 25  0   4048 1184 3704 S  0.0  0.2  0:00.01 saslauthd
```

As you can see, vztop provides an ongoing look at the processor activity in real time (the display is updated every 5 seconds by default, but you can change that with the d command-line option or the s interactive command). It displays a list of the most CPU-intensive tasks on the system and can provide an interactive interface for manipulating processes. It can sort the tasks by CPU usage, memory usage, and runtime. Specifying 101 after the -E option allows you to display only those processes that are running inside Container 101 only. Besides, most features can be selected by an interactive command, for example, the e and E commands described above.

Note: For more information on all vztop parameters, please consult its man pages. Besides, you can find information on some fields in the Viewing Active Processes subsection (p. 195).

In Parallels Management Console, you can view those processes that are currently running on your Hardware Node and/or inside your Container(s). To display the processes, click the Hardware Node name where you wish to monitor processes and then select Monitor --> Processes. A list of the Host OS or Container OS processes should appear in the right pane:

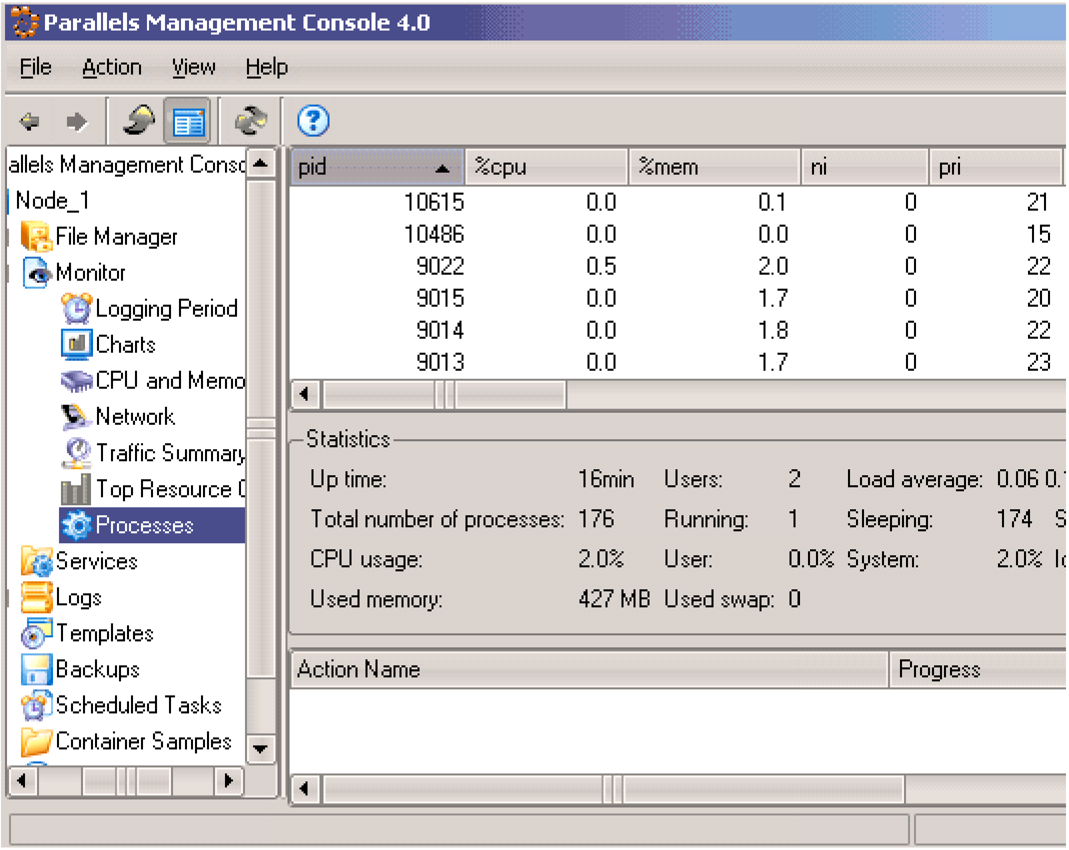

Figure 65: Management Console - Monitoring Active Processes

The column names and their description is presented in the table below:

Column name	Description
`pid`	The identifier of the process.
`%cpu`	The CPU time, in percent, used by the process.
`%mem`	The memory used by the process.
`ni`	The 'nice' parameter; weights the overall scheduling priority for the process.
`pri`	The kernel scheduling priority for the process.
`rss`	Number of resident pages for the swap-out guarantee (the resident set size).
`stat`	The process current status. Can be 'R' (running), 'S' (sleeping, waiting for 'wake-up call)', 'D' (uninterruptable sleep), 'Z' (zombie, waiting for parent process), 'T' (stopped or traced). Sometimes the second symbol may appear: 'W' (process swapping), 'N' ('niced' process), 'L' (process has pages locked into memory). If the < sign is displayed after the status, it means that this information was returned by the Parallels Agent software which, in turn, got this information from the `ps` tool.
`time`	The total CPU time the process has used.
`user`	The user who has launched the process.
`veid`	The ID of the Container where the process is running.

`command`	The command that invoked the process.

To view the processes inside a Container, double-click on its name and select Monitor --> Processes.

Note: Starting with Virtuozzo Containers 3.0, the IDs of the processes running inside your Containers displayed by selecting Monitor --> Processes on the Hardware Node does not coincide with the IDs of the same processes shown when opening the Container Manager window and selecting Monitor --> Processes.

You can send different signals to process by right-clicking a process and selecting the corresponding signal on the pop-up menu.

Changing Services Mode

xinetd is a service used to start and stop a variety of data communication services. xinetd starts on the Hardware Node startup and waits for a connection request from a remote client that wants to connect to the server. There can be a number of remote clients in the network, and each of them can use different network protocols to establish connection to the server. In order not to run all network services responsible for this or that protocol, which will negatively influence the system performance, the system starts only the xinetd service. This service controls all other network services and, at the connection time, it starts the corresponding service to process this connection. In such a way, xinetd saves system resources allowing you to run only those network services in the system that are really needed at the moment.

The vzsetxinetd utility allows you to switch Container services between the standalone and xinetd mode. The services that can be either standalone or dependent on xinetd in the current release of Parallels Virtuozzo Containers are sendmail, sshd, proftpd, and courier-imap. Whereas they are xinetd-dependent by default in order to consume less resources, you may want to make them standalone due to the following reasons:

- The CPanel application does not recognize sshd if it is dependent on xinetd;
- sendmail does not process some rules correctly if it is dependent on xinetd;
- A number of control panel applications and some others are not able to manage xinetd-based services at all.

The courier-imapd, courier-imapds, courier-pop3d, and courier-pop3ds services are provided by the courier-imap service, thus vzsetxinetd can manage these services via the courier-imap service.

Let us assume that you wish to check the mode of the sendmail service and set it to standalone if it is in the xinetd mode. First, you should check the current status of the sendmail service. To this effect, type the following command in the command line:

```
# vzsetxinetd -s 222 sendmail
```

where 222 is the Container ID, sendmail denotes the name of the corresponding service, and the -s option gets the status of the sendmail service of the Container with ID 222. The output will tell you if this service has the standalone or xinetd mode:

```
sendmail is xinetd service
```

In our case it is in the xinetd mode. Now you can change the mode of the sendmail service to standalone. To make it standalone, type the following line:

```
# vzsetxinetd 222 sendmail off
sendmail is standalone service
```

where off specifies that the sendmail service should be set to the standalone mode. The output confirms that the sendmail service is now standalone.

For more information on the vzsetxinetd utility, please consult the corresponding man pages or turn to the Parallels Virtuozzo Containers Reference Guide.

Note: You cannot use the vzsetxinetd utility to change the mode of the xinetd-dependent services in Containers where the Debian 3.0 OS template is installed.

Determining Container Identifier by Process ID

Each process is identified by a unique PID (process identifier), which is the entry of that process in the kernel's process table. For example, when you start Apache, it is assigned a process ID. This PID is then used to monitor and control this program.The PID is always a positive integer. In Parallels Virtuozzo Containers you can use the `vzpid` (retrieve process ID) utility to print the Container ID the process with the given id belongs to. Multiple process IDs can be specified as arguments. In this case the utility will print the Container number for each of the processes.

The typical output of the `vzpid` utility is shown below:

```
# vzpid 12
Pid     VEID    Name
12       4      init
```

In our example the process with the identifier 12 has the name 'init' and is running in the Container with ID = 4.

Note: You can also display the Container ID where the corresponding process is running by using the `vzps` utility.

Starting, Stopping, and Restarting Services

Parallels Management Console allows you to manage the services present in the Host Operating System of the Hardware Node or in a Container. Click the **Services** item in the tree below the Hardware Node nameor the Container name. A list of the Host OS or Container OS services should appear in the right pane:

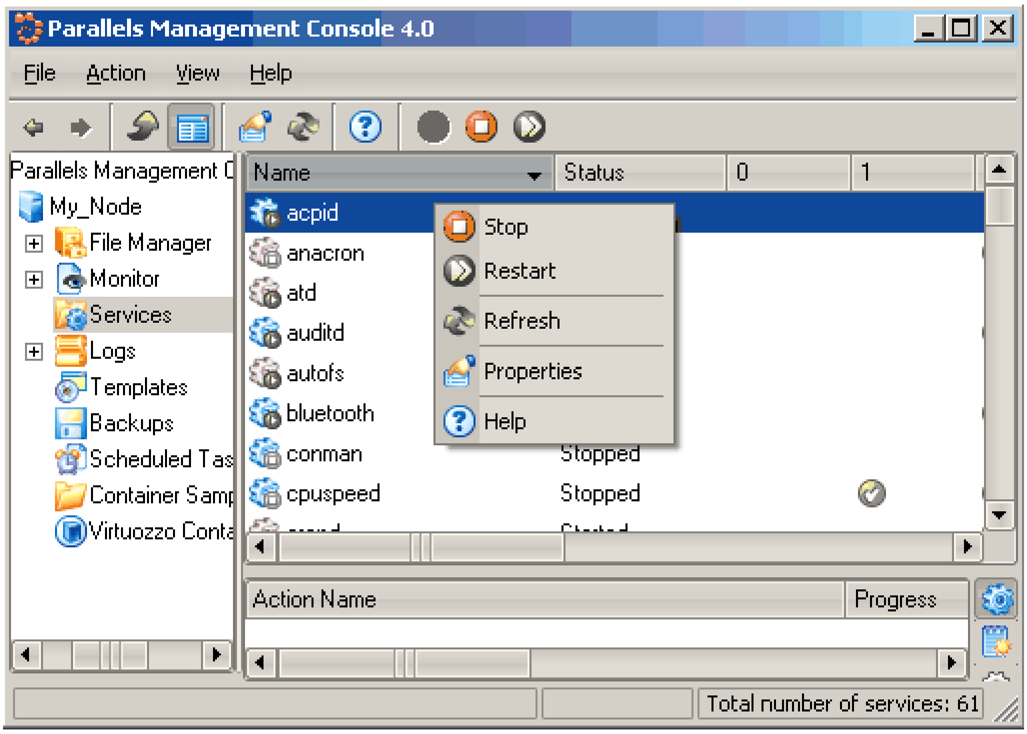

Figure 66: Management Console - Managing Processes and Services

To start, stop, or restart a service, select its line in the table and either use the pop-up menu or the buttons on the toolbar. For `xinetd`-dependent services (the services having `xinetd` in parentheses beside their name), you do not start and stop but enable and disable services. The services enabled in this way are started and stopped on the basis of the corresponding state of the `xinetd` daemon. Disabled services are not started whatever the `xinetd` state.

To edit the default run levels for the service, use the **Properties** item on the context menu or just double–click on the service name within the list. When the **Properties** dialog is open, select the check boxes of the run levels on which the service will start automatically. Click the **OK** button to apply your settings. If the service is dependent on `xinetd`, you cannot choose its run levels, as the latter are determined by the `xinetd` daemon. Besides, you cannot change run levels for certain services, which means that they are critical and you are not allowed to change their run levels.

You can also manage (i.e. start, stop, and restart) services by using the command line. For example, you wish to start the `httpd` service. To this effect, you should type the following command:

```
[root@ct222 /]# service httpd start
```

where service is the standard Linux command, httpd denotes the name of the corresponding service, and start is the command that will launch this service. In order to check that the httpd service was successfully launched, you can either type the following Linux command:

```
[root@ct222 /]# service httpd status
```

or use the vzps utility when working on your Hardware Node or the ps utility when working inside your Container(s) and passing them the x argument. The output will tell you if the httpd service is running in your system or not.

CHAPTER 7

Managing Virtuozzo Network

The given chapter familiarizes you with the Virtuozzo network structure, enumerates Virtuozzo networking components, and explains how to manage these components in Virtuozzo-based systems. In particular, it provides information on:

- How you can manage physical and VLAN adapters on the Hardware Node;
- What Virtual Networks are and how you can manage them on the Hardware Node;
- What the `venet0` networking mode is and how to make your Containers operate in this mode;
- What the `veth` networking mode is and how to make your Containers operate in this mode;
- How to create `veth` virtual network adapters inside your Containers and configure their parameters;
- How to connect Containers to LANs (Local Area Networks) and VLANs (Virtual Local Area Networks).

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Managing Network Adapters on Hardware Node

Physical and VLAN (Virtual Local Area Network) adapters installed on the Hardware Node are used to provide Containers with access to each other and to external networks. During the Parallels Virtuozzo Containers installation, all physical and VLAN network adapters on the Node are registered with Virtuozzo Containers 4.0, which allows you to perform the following operations on these adapters:

- list the adapters currently installed on the Hardware Node;
- create new VLAN adapters on the Hardware Node;
- connect adapters to Virtual Networks on the Hardware Node.

Both operations are described in the following subsections in detail.

Listing Adapters

You can view the physical and VLAN network adapters currently installed on your Hardware Node using the `vznetcfg` Virtuozzo utility. For example, you can execute the following command to find out what network adapters are available on your Node:

```
# vznetcfg if list
Name     Type   Network ID   Addresses
eth0     nic                 192.168.0.170/22,dhcp
```

As can be seen from the command output, only one physical adapter - `eth0` - is currently installed on the Hardware Node. The information on adapters produced by `vznetcfg` is presented in the table having the following columns:

Column Name	Description
Name	The adapter name.
Type	The type of the network adapter which can be one of the following: ▪ `nic` denotes a physical adapter; ▪ `vlan` stands for a VLAN adapter.
Network ID	The ID of the Virtual Network where the network adapter is connected. Detailed information on Virtual Networks is provided in the **Managing Virtual Networks** section (p. 211).
Addresses	The IP address(es) and subnet mask(s) assigned to the network adapter.

In Parallels Management Console, you can list all available adapters on the Node by right-clicking the needed Hardware Node and selecting Network Configuration --> Configure Network Adapters on the context menu:

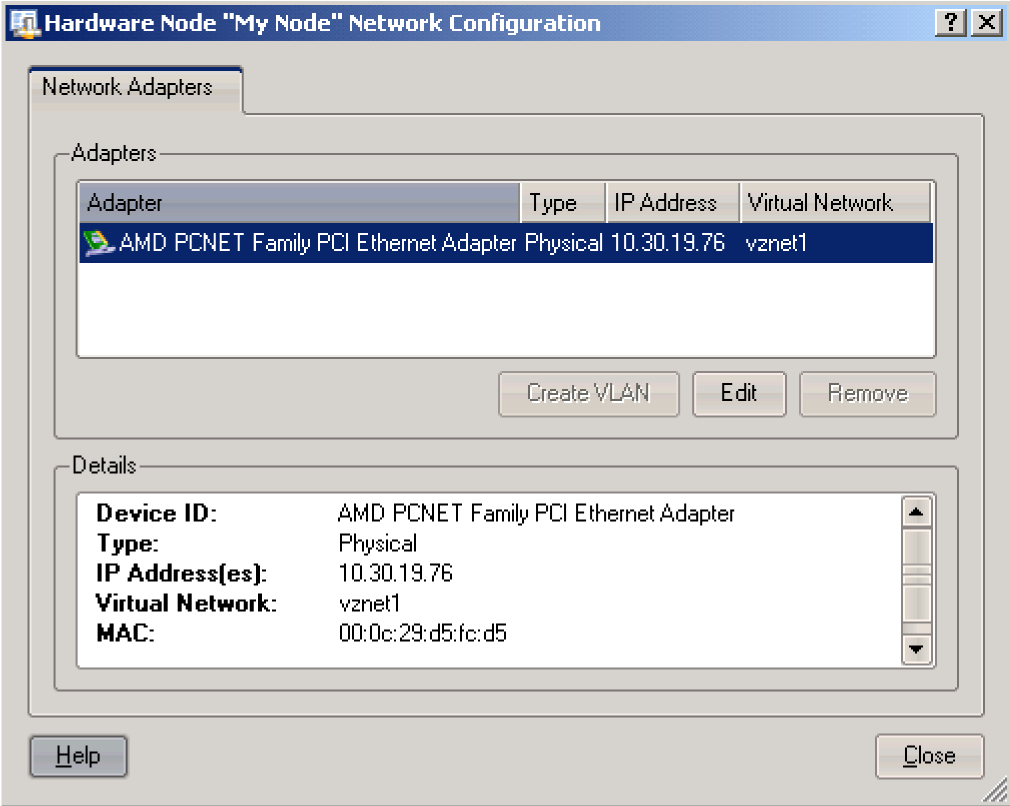


Figure 67: Management Console - Listing Network Adapters

The Adapters table in the displayed window lists all the network adapters currently available on the Node. To view detailed information on the corresponding adapter, select its name in the Adapters table. All adapter-related data (its name, type, the MAC and IP address assigned to the adapter, etc.) will be shown in the Details table at the bottom of the Hardware Node Network Configuration window.

Creating VLAN Adapter

Parallels Virtuozzo Containers allows you to create new VLAN adapters on the Hardware Node. You can use these adapters later on to connect your Containers to any of the available Virtuozzo Virtual Networks (for more information on Virtual Networks, please turn to the **Managing Virtual Networks** section (p. 211)). VLAN adapters can be made using the `vznetcfg vlan add` command. To create a new VLAN adapter, you should specify the VLAN ID - an arbitrary integer number which will uniquely identify the virtual LAN among other VLANs on the Hardware Node - and the physical network adapter on the Node to which the VLAN is to be bound. For example, you can execute the following command to make a new VLAN adapter on the Node, associate it with a VLAN having the ID of 5 (i.e. with VLAN 5), and attach the VLAN adapter to the `eth0` physical adapter on the Hardware Node:

```
# vznetcfg vlan add eth0 5
```

To check that the VLAN adapter has been successfully created on the Hardware Node, you can execute the following command:

```
# vznetcfg if list
Name       Type    Network ID   Addresses
eth0       nic                  192.168.0.150/22,dhcp
eth0.5     vlan
```

VLAN adapters can be easily identified by the `vlan` designation shown in the `Type` column of the command output. As you can see, there is only one VLAN adapter currently existing on the Hardware Node. It is assigned the name of `eth0.5` which is automatically generated on the basis of the specified VLAN ID and the name of the physical adapter to which the VLAN adapter is tied.

At any time you can delete the `eth0.5` VLAN adapter and thus destroy VLAN 5 by issuing the following command on the Node:

```
# vznetcfg vlan del eth0.5
# vznetcfg if list
Name       Type    Network ID   Addresses
eth0       nic                  192.168.0.150/22,dhcp
```

To create a new VLAN adapter in Parallels Management Console, you should complete the following tasks:

1 Right-click the needed Hardware Node and select **Network Configuration --> Configure Network Adapters** on the context menu.

2 In the **Hardware Node Network Configuration** window, click the **Create VLAN** button:

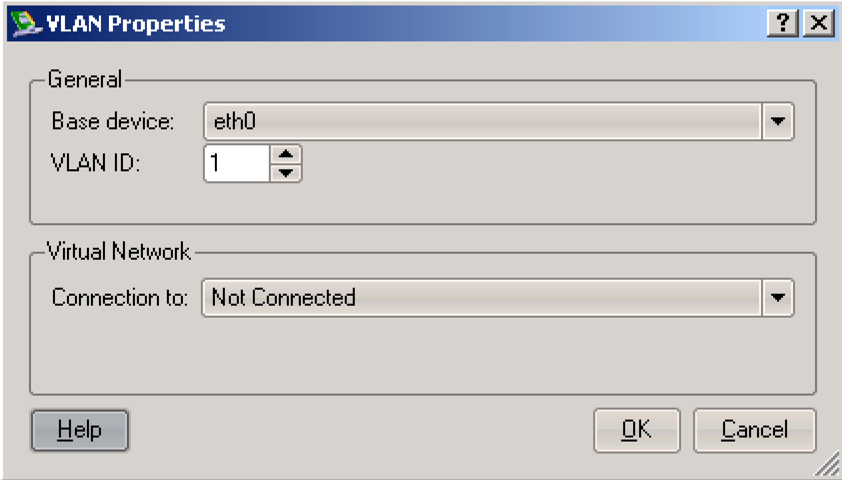


Figure 68: Management Console - Creating VLAN Adapter

3 The **VLAN Properties** window allows you to set the following parameters for the VLAN adapter:

- **Base device**: choose the physical network adapter on the Hardware Node where the VLAN adapter is to be bound.
- **VLAN ID**: specify the VLAN ID - an arbitrary integer number which will uniquely identify the virtual LAN among other VLANs on the Hardware Node.

4 Click **OK**.

At any time, you can remove any of the VLAN adapters existing on the Hardware Node by selecting its name in the **Adapters** table and clicking the **Remove** button at the bottom of the table.

Note: By default, all VLANs created on the Hardware Node by means of Parallels Infrastructure Manager, Parallels Management Console, or the `vznetcfg` utility are in the 'down' state. To enable a newly created VLAN, assign a valid IP address to it and then bring the VLAN to the running state using the Linux `ip` utility.

Connecting Adapter to Virtual Network

Connecting a physical or VLAN adapter to a Virtual Network allows you to join all Containers included in the Virtual Network to the network (either LAN or VLAN) where the corresponding adapter is connected.

Let us assume the following:

- The `eth0` physical adapter and the `vznetwork1` Virtual Network exist on the Hardware Node. For information on how to create Virtual Networks, please turn to the **Creating Virtual Network** subsection (p. 212).
- The `eth0` physical adapter is connected to the local network.
- Container 101 and Container 102 are connected to the `vznetwork1` Virtual Network. Detailed information on how to join Containers to Virtual Networks is given in the **Connecting Containers to Virtual Networks** subsection (p. 224).

To connect the `eth0` adapter to the `vznetwork1` Virtual Network and thus to join Container 101 and 102 to the local network, you should issue the following command on the Node:

```
# vznetcfg net addif vznetwork1 eth0
```

To check that the `eth0` physical adapter has been successfully added to the `vznetwork1` Virtual Network, you can execute the following command:

```
# vznetcfg if list
Name     Type   Network ID   Addresses
eth0     nic    vznetwork1   192.168.0.170/22,dhcp
...
```

As you can see, the `eth0` adapter is now joined to the `vznetwork1` Virtual Network, which means that Container 101 and 102 whose virtual network adapters are connected to `vznetwork1` can access the local network behind `eth0`.

At any time you can disconnect the `eth0` physical adapter from the `vznetwork1` Virtual Network (and thus detach Container 101 and 102 from the local network) by running the following command:

```
# vznetcfg net delif eth0
```

To check that the physical adapter has been successfully disconnected from `vznetwork1`, issue the following command:

```
# vznetcfg if list
Name     Type   Network ID   Addresses
eth0     nic                 192.168.0.170/22,dhcp
...
```

To join a physical or VLAN adapter to a Virtual Network in Parallels Management Console, do the following:

1. Right-click the needed Hardware Node and select **Network Configuration** --> **Configure Network Adapters** on the context menu.
2. In the **Hardware Node Network Configuration** window, select the name of the network adapter (either physical or VLAN) to be joined to a Virtual Network and click **Edit** button.
3. Under **Virtual Network**, choose on the drop-down menu the Virtual Network where you wish to join the network adapter:

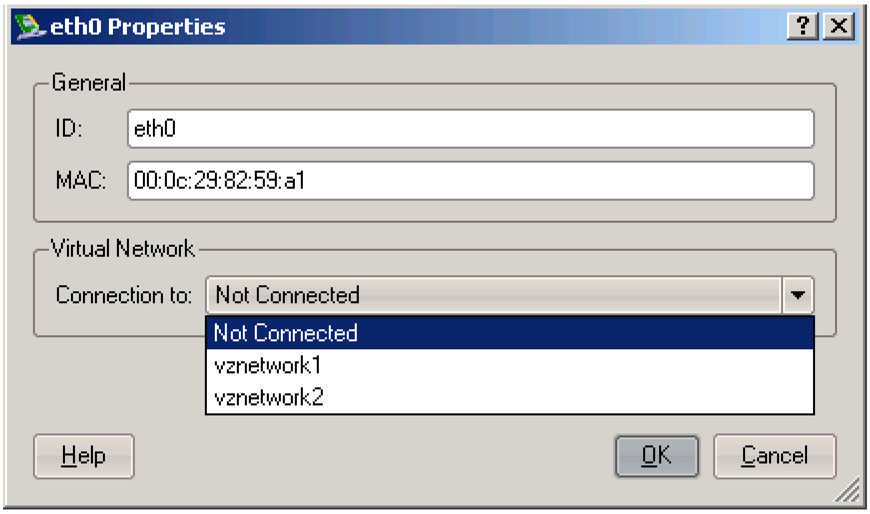


Figure 69: Management Console - Connecting Adapter to Virtual Network

4 Click **OK**.

To disconnect an adapter from the corresponding Virtual Network, perform **Steps 1** and **2** above and, in the **Properties** window, choose `Not connected` on the drop-down menu.

Managing Virtual Networks

A Virtuozzo Virtual Network acts as a binding interface between a Container virtual network adapter and the corresponding physical or VLAN adapter on the Hardware Node allowing you to include your Containers in different networks (local or VLAN). Parallels Virtuozzo Containers 4.0 enables you to manage Virtual Networks as follows:

- create a new Virtual Network on the Hardware Node and remove an existing one;
- list the Virtual Networks currently existing on the Hardware Node and configure their properties;
- delete a Virtual Network that you do need any more from the Hardware Node.

Both operations are described in the following subsections in detail.

Creating Virtual Network

Virtual Networks serve as binding interfaces between the `veth` virtual network adapters inside Containers and the physical/VLAN adapters on the Hardware Node allowing you to connect the corresponding Containers to different LANs and VLANs. New Virtual Networks can be created using the `vznetcfg` utility. For example, to make a new Virtual Network with the name of `vznetwork1`, you can issue the following command:

```
# vznetcfg net new vznetwork1
```

To check that `vznetwork1` has been successfully created on the Hardware Node, you can execute the following command:

```
# vznetcfg net list
Network ID   Status  Master Interface Slave Interfaces
vznetwork1   active
```

You can see that the `vznetwork1` Virtual Network is now available on the Node.

Each Virtual Network is associated with some bridge which is automatically made on the Hardware Node during the Virtual Network creation and serves as the basis for the Virtual Network functioning. To find out what bridge is associated with what Virtual Network, you can:

- issue the following command:

```
# vznetcfg if list
Name             Type       Network ID       Addresses
eth0             nic        vznetwork1       192.168.0.150/22,dhcp
br0              bridge     vznetwork1
...
```

  The command output that the `vznetwork1` Virtual Network is bound to the `br0` bridge on the Node.

- check the `/etc/vz/vznet.conf` file on the Node:

```
# cat /etc/vz/vznet.conf
VNID_br0="vznetwork1"
...
```

  In the output above, the name of the bridge - `br0` - is a component of the `VNID_br0` parameter defining the Virtual Network name.

Note: Detailed information on the `vznetcfg` utility and the `/etc/vz/vznet.conf` file is provided in Parallels Virtuozzo Containers Reference Guide.

To create a new Virtual Network in Parallels Management Console, you should perform the following operations:

1 Right-click the needed Hardware Node and select Network Configuration --> Configure Virtual Networks on the context menu.

2 In the Virtual Networks window, click the Add button:

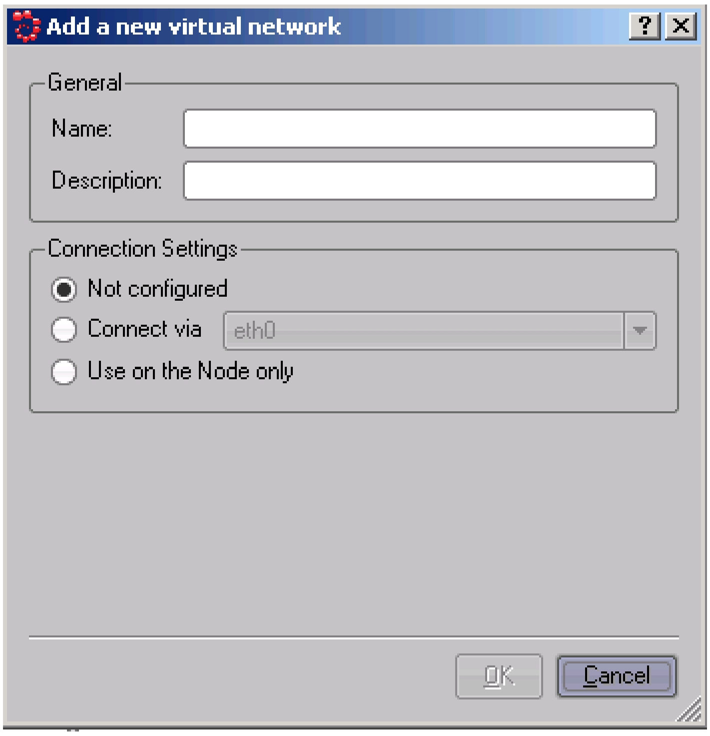


Figure 70: Management Console - Creating Virtual Network

3 Specify an arbitrary name for the Virtual Network in the Name field and provide its description, if necessary, in the Description field.

4 Click OK.

Listing Virtual Networks

Sometimes, you may wish to list all Virtual Networks currently existing on the Hardware Node. To this effect, you should execute the following command on the Hardware Node:

```
# vznetcfg net list
Network ID    Status   Master Interface  Slave Interfaces
vznetwork1    active   eth0
vznetwork2    active
```

In the example above, two Virtual Networks - `vznetwork1` and `vznetwork2` - exist on the Hardware Node. The information on these Virtual Networks is presented in the table having the following columns:

`Network ID` The name assigned to the Virtual Network.

`Status`	Indicates the status of the Virtual Network. It can be one of the following: ▪ `active`: the Virtual Network is up and running. ▪ `configured`: the information on the Virtual Network is present in the `/etc/vz/vznet.conf` file on the Hardware Node; however, the bridge to which the Virtual Network is bound is down or absent from the Node. **Note:** Detailed information on the `vznet.conf` file is given in the Parallels Virtuozzo Containers Reference Guide.
`Master Interface`	The name of the physical/VLAN adapter on the Hardware Node connected to the Virtual Network, if any.
`Slave Interfaces`	The name of the `veth` virtual network adapters joined to the Virtual Network, if any.

To list the Virtual Network on the Node in Parallels Management Console, you can do the following:

1 Right-click the needed Hardware Node and select Network Configuration --> Configure Virtual Networks on the context menu:

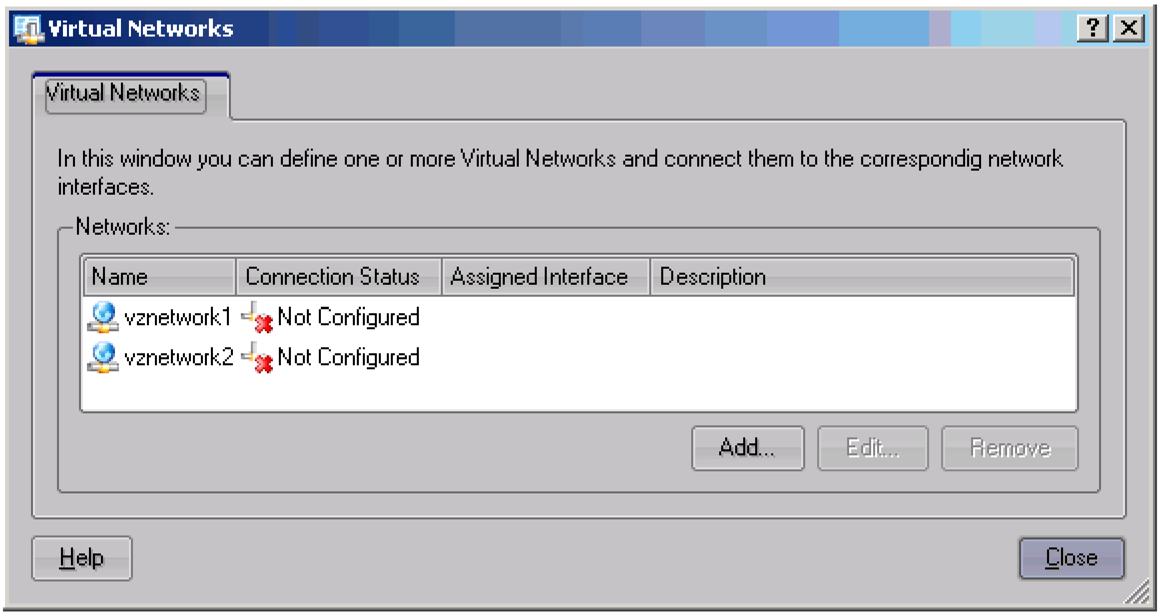


Figure 71: Management Console - Listing Virtual Networks

2 The Virtual Networks window lists all the Virtual Networks currently existing on the Hardware Node.

Deleting Virtual Network

At any time, you can remove a Virtual Network that you do not need any more from the Hardware Node. For example, you can delete the `vznetwork1` Virtual Network by running the following command:

```
# vznetcfg net del vznetwork1
```

To check that `vznetwork1` has been successfully remove from the Node, issue the following command:

```
# vznetcfg net list
Network ID   Status  Master Interface Slave Interfaces
vznetwork2   active
```

Note: Detailed information on the `vznetcfg` utility and all its options is provided in the Parallels Virtuozzo Containers Reference Guide and the `vznetcfg` manual pages.

To remove an existing Virtual Network from the Hardware Node in Parallels Management Console, do the following:

1 Right-click the needed Hardware Node and select **Network Configuration** --> **Configure Virtual Networks** on the context menu.

2 In the **Virtual Networks** window, select the name of the Virtual Network you wish to delete and click the **Remove** button.

Managing Virtual Network Adapters

Parallels Virtuozzo Containers 4.0 provides you with ample opportunities of configuring virtual network adapters inside Containers and including them in different network environments. The given section starts with the explanation of the two network modes - `venet0` and `veth` - in which any Container can operate and then shows you the way to:

- create new virtual network adapters inside your Containers and delete existing ones;
- configure the parameters of an existing virtual network adapter (e.g. assign an IP address to it);
- join Container virtual network adapters to Virtual Networks on the Hardware Node, thus, connecting them to external networks (either LANs or VLANs).

All these operations are described in the following subsections in detail.

Container Networking Modes

In Parallels Virtuozzo Containers 4.0, any Container can operate in one of the two operating modes:

- *venet0* mode;
- *veth* mode.

Detailed information on these operating modes is provided in the following subsections.

venet0 Mode

By default, all the Containers on the Hardware Node are operating in the `venet0` mode, which means that they are connected among themselves and with the Node using a virtual network adapter called `venet0`. The picture below provides an example of the Virtuozzo network structure when all Containers (`Container #1`, `Container #2`, `Container #3`) on the Node are functioning in the `venet0` mode:

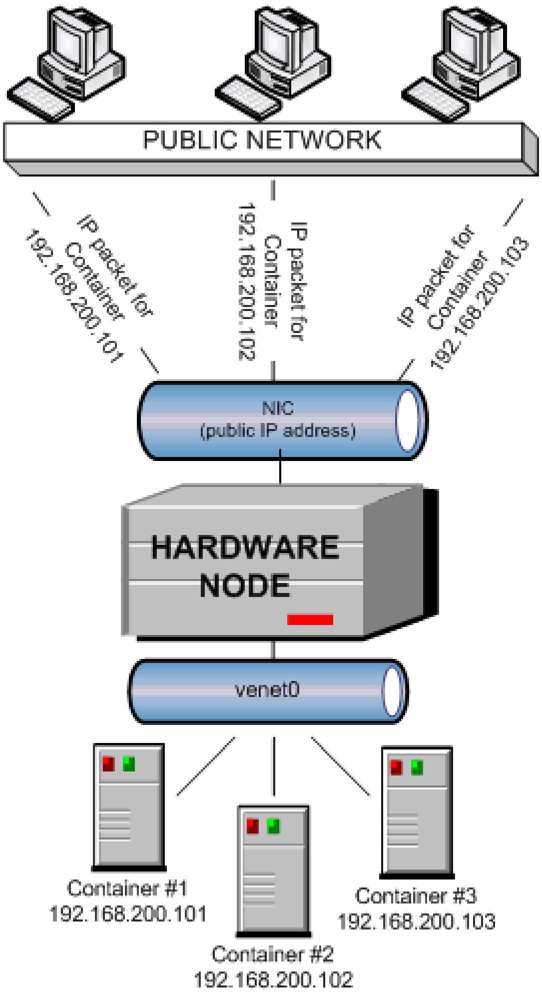


Figure 72: Virtuozzo Networking - venet0 Mode

All Containers on the Hardware Node use the `venet0` virtual adapter as the default gateway to send and receive data to/from other networks (shown as the *PUBLIC NETWORK* in the picture above). The procedure of handling incoming and outgoing IP packets may be described as follows:

- All IP packets from Containers operating in the `venet0` mode come to this adapter and are redirected through a public IP address of the Hardware Node to the corresponding server on the public network.
- All IP packets coming from external networks and destined for Container IP addresses reach the public IP address of the Hardware Node first and, afterwards, are sent through `venet0` to the IP addresses of the corresponding Containers.

The `venet0` adapter is also used to exchange the traffic among all the Containers hosted on the given Hardware Node. All the network traffic of a Container is isolated from that of the other Containers, i.e. all Containers are protected from each other in the way that makes traffic snooping impossible.

veth Mode

Starting with Parallels Virtuozzo Containers 3.0 SP1, you can also create special `veth` virtual adapters inside your Containers and make the Containers operate in the `veth` mode. The following figure represents an example of the Virtuozzo network structure where all Containers (`Container#1` and `Container#2`) are operating in the `veth` mode:

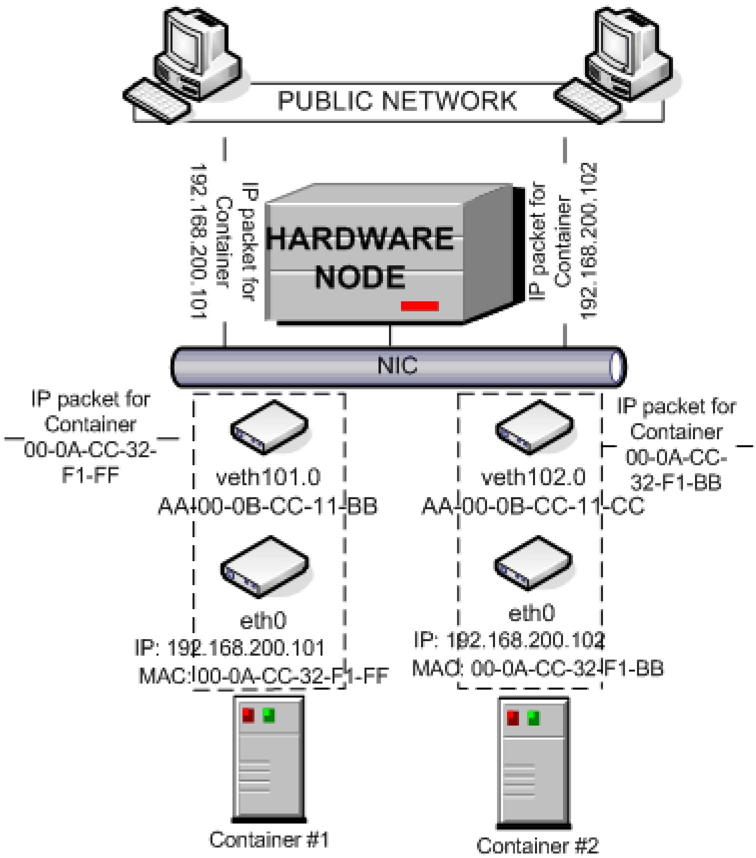


Figure 73: Virtuozzo Networking - veth Mode

In the `veth` mode, a separate `veth` virtual adapter is created for each Container on the Hardware Node. You are allowed to create several `veth` adapters for a Container. Any `veth` virtual adapter consists of two interfaces:

- An Ethernet interface inside the Container. This interface represents a counterpart of a physical network adapter installed on a standalone server. As any other physical adapter, it has a MAC address (e.g., `00-0A-CC-32-F1-FF` and `00-0A-CC-32-F1-BB`), can be assigned one or more IP addresses (e.g., `192.168.200.101` and `192.168.200.102`) and included in different network environments, etc. Please turn to the **Managing veth Virtual Network Adapters** section (p. 215) for detailed information on all the parameters which can be configured for Ethernet interfaces inside Containers.

- An Ethernet interface on the Hardware Node. This interface is responsible for the adapter operation in the Hardware Node context and mostly used to maintain the interaction and communication between the Node and the Ethernet interface inside the Container. Each Ethernet interface on the Hardware Node should be assigned a MAC address (e.g., `AA-00-0B-CC-11-BB` and `AA-00-0B-CC-11-CC`). Detailed information on how to manage Ethernet interfaces on the Hardware Node is provided in the **Managing veth Virtual Network Adapters** section (p. 215).

Both interfaces are closely linked to each other, which means that an IP packet entering one interface will always come out from the other one.

Differences Between venet0 and veth Modes

The `veth` mode demonstrates the following differences as compared to the `venet0` mode:

- Each of the Ethernet interfaces constituting a `veth` virtual adapter has a MAC address assigned to it while `venet0` does not have any. Thanks to this fact:
  - Any Container can see all broadcast and multicast packets received from or sent to the selected network adapter on the Hardware Node.
  - Using a `veth` virtual adapter inside a Container allows you to host a DHCP or Samba server inside this Container, etc.
- There is no more need to assign all network settings (IP addresses, subnet mask, gateway, etc.) to a Container from the Host OS. All network parameters can be set from inside the Container.
- `veth` adapters can be bridged among themselves and with other devices. If several `veth` adapters are united into a bridge, this bridge can be used to handle network traffic for the Containers whose `veth` adapters are included in the bridge.
- Due to the fact that `veth` adapters act as full members of the Virtuozzo network (rather than 'hidden' beyond `venet0`), they are more prone to security vulnerabilities: traffic sniffing, IP address collisions, etc. Therefore, `veth` adapters are recommended to be used in trusted network environments only.
- The `veth` mode has poorer scalability than the `venet0` mode. This is caused by the fact that any broadcast packet meant for any `veth` virtual network adapter is duplicated and transmitted to all available `veth` network adapters, which requires the CPU(s) on the Hardware Node to process all the resulting broadcast packets and may noticeably degrade the system performance. So, we highly recommend that you create no more than 100 `veth` network adapters for every CPU on the Node.

Creating and Deleting veth Network Adapters

By default, any Container on the Hardware Node starts functioning in the `venet0` mode right after its creation. However, at any time you can create additional virtual adapters for your Container and set them to work in the `veth` mode. This can be done by using the `--netif_add` option of the `vzctl set` command.

Let us assume that you wish to create a new virtual adapter with the name of `eth1` inside Container 101 and make it function in the `veth` mode. To this effect, you can execute the following command on the Hardware Node:

```
# vzctl set 101 --netif_add eth1 --save
Saved parameters for Container 101
```

The settings of the newly created virtual adapter are saved as the value of the `NETIF` parameter in the configuration file of Container 101 (`/etc/vz/conf/101.conf`). So, you can use the following command to display the parameters assigned to the `veth` network adapter inside Container 101:

```
# grep NETIF /etc/vz/conf/101.conf
NETIF="ifname=eth1,mac=00:10:41:F0:AA:B6,host_mac=00:18:51:A0:8A:D7"
```

As you can see, the parameters set for the `veth` virtual network adapter during its creation are the following:

- `ifname`: the name set for the `veth` Ethernet interface inside Container 101. You specified this name when creating the Container virtual network adapter. Usually, names of Ethernet interfaces inside Containers are set in the form of `eth`*`Ad_N`* where *`Ad_N`* denotes the index number of the created adapter (e.g. `eth0` or `eth1`); however, you can choose any other name you like and specify it during the virtual adapter creation.
- `mac`: the MAC address assigned to the `veth` Ethernet interface inside Container 101.
- `host_mac`: the MAC address assigned to the `veth` Ethernet interface on the Hardware Node.

`ifname` is the only mandatory parameter that should be indicated when creating a Container virtual network adapter. All the other parameters are optional and generated by Parallels Virtuozzo Containers automatically, if not specified.

At any time, you can remove the `veth` virtual network adapter inside Container 101 by executing the following command:

```
# vzctl set 101 --netif_del eth1 --save
Saved parameters for Container 101
# grep NETIF /etc/vz/conf/101.conf
NETIF=""
```

In Parallels Management Console, you can create a new virtual network adapter or delete an existing one by performing the following operations:

1 Select the **Virtuozzo Containers** item under the corresponding Hardware Node name.

2 Right-click the Container for which you wish to make the adapter and select **Properties** on the context menu.

3 Go to the **Network** tab of the displayed window and select the **Network Adapters** item in the left part of the window:

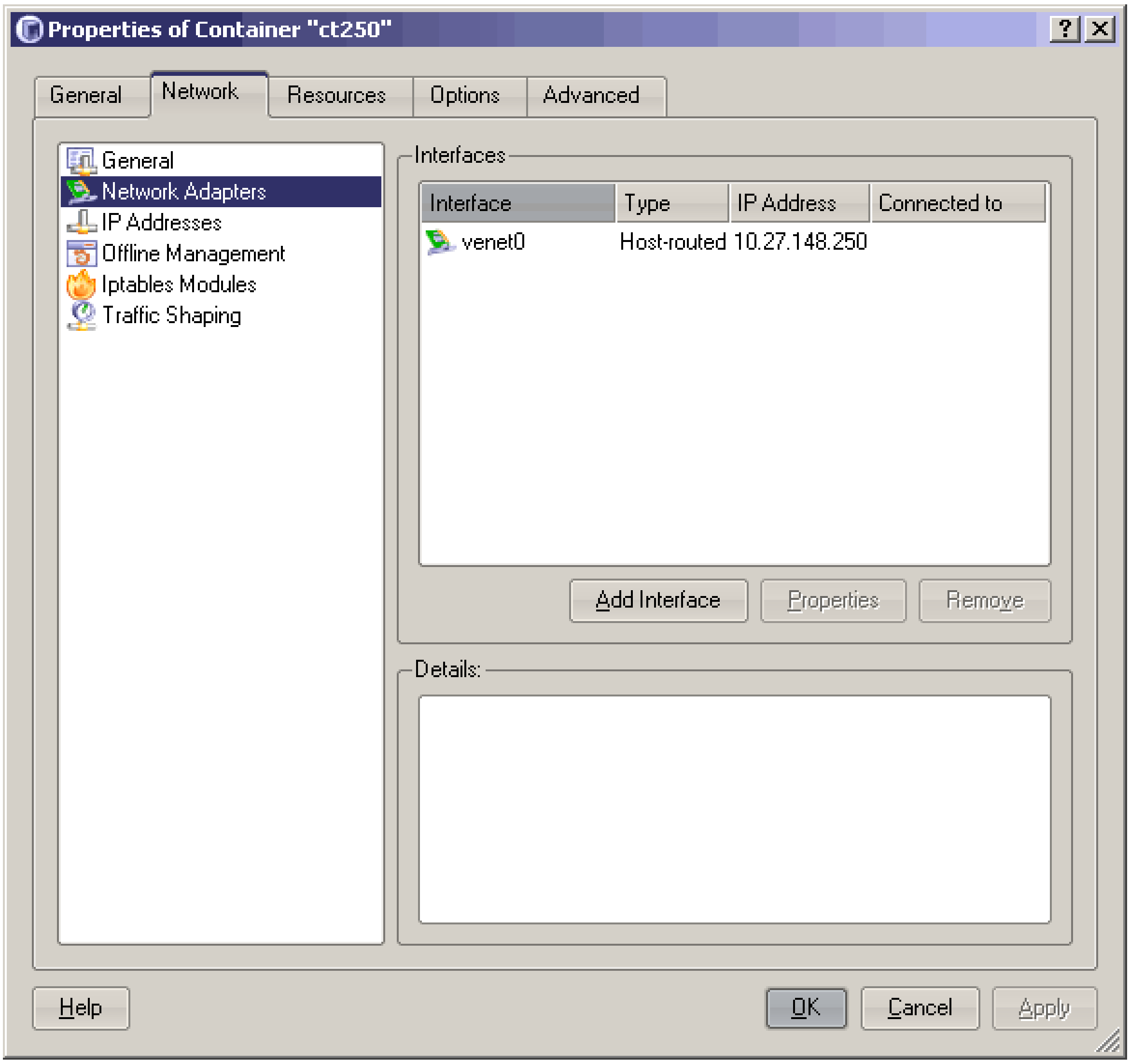


Figure 74: Management Console - Managing Container Adapters

4 In the right part of the window, use either the Add Interface or Remove button to create or delete the virtual network adapter.

5 Click OK.

Configuring veth Adapter Parameters

While functioning in the `veth` mode, each Container virtual network adapter appears as a full participant on the network to which it is connected and needs to have its own identity on this network.

Fist of all, to start functioning on a TCP/IP network, a `veth` virtual adapter should be assigned one or several IP addresses. This can be done as follows:

Note: For detailed information on all parameters that can be configured for each default Container network adapter (i.e. for the adapter operating in the `venet0` mode), please turn to the Configuring Container section (p. 46).

```
# vzctl set 101 --ifname eth1 --ipadd 192.168.144.123 --save
Saved parameters for Container 101
```

This command will set an IP address of `192.168.144.123` for the `eth1` adapter inside Container 101. If you wish to use the Dynamic Host Configuration Protocol (DHCP) to make the `eth1` adapter of Container 101 automatically receive TCP/IP configuration settings, you can issue the following command instead:

```
# vzctl set 101 --ifname eth1 --dhcp yes --save
Saved parameters for Container 101
```

Any static IP address assigned to the Container virtual network adapter can be removed by executing the following command:

```
# vzctl set 101 --ifname eth1 --ipdel 192.168.144.123 --save
Saved parameters for Container 101
```

You can also delete all IP addresses set for Container 101 at once:

```
# vzctl set 101 --ifname eth1 --ipdel all --save
Saved parameters for Container 101
```

You may also wish to set the following parameters for a Container network adapter:

- one or more DNS servers that the Container virtual adapter is supposed to use:

```
# vzctl set 101 --ifname eth1 --nameserver 192.168.100.111 --save
Saved parameters for Container 101
```

- and a gateway to be used for routing the traffic of the Container virtual adapter:

```
# vzctl set 101 --ifname eth1 --gateway 192.168.111.1 --save
Saved parameters for Container 101
```

Detailed information on all options which can be used with the `vzctl set` command to manage Container adapter parameters is given in Parallels Virtuozzo Containers Reference Guide and the `vzctl` manual pages.

To configure the aforementioned adapter settings in Management Console, do the following:

1. Select the Virtuozzo Containers item under the corresponding Hardware Node name.
2. Right-click the Container whose network adapter settings you wish to configure and select Properties on the context menu.
3. In the displayed window, go to the Network tab and select the Network Adapters item in the left part of the window. A list of network adapters currently existing inside the Container will be shown in the Interfaces table in the right part of the window.

4 Select the network adapter the network settings of which you wish to configure and click the **Properties** button at the bottom of the **Interfaces** table:

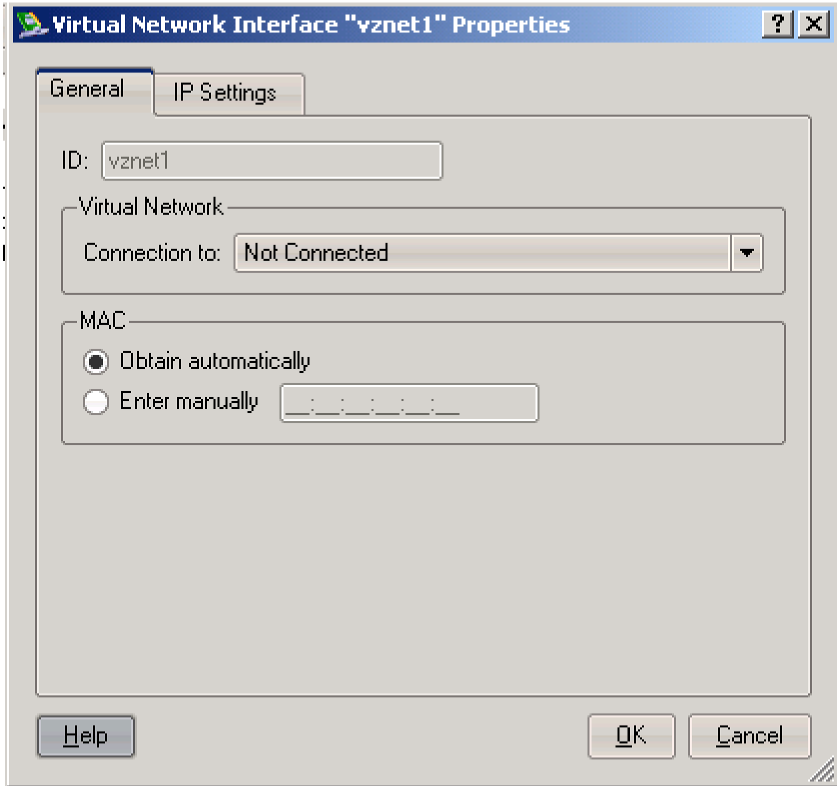


Figure 75: Management Console - Configuring Container Adapter Parameters

5 In this window you can configure the following adapter parameters:

On the **General** tab of the **Virtual Network Interface Properties** window:

- Change the MAC address assigned to the `veth` Ethernet interface inside the Container by entering the needed MAC address in the **Enter manually** field.
- Connect the Container virtual network adapter to a Virtual Network by clicking the down arrow in the **Connection to** field and selecting the desired Virtual Network on the context menu. Detailed information on how to connect Containers to Virtual Networks is provided in the **Connecting Containers to Virtual Networks** (p. 224) subsection.

On the **IP Settings** tab of the **Virtual Network Interface Properties** window:

- configure the network adapter IP addresses:

a Select the **Obtain IP address via DHCP** radio button to make the adapter automatically receive its IP address and the information on the default gateway through the Dynamic Host Configuration Protocol (DHCP).

b Select the **Get IP address from pool** radio button to make the adapter automatically receive its IP address from the IP addresses pool configured on the Hardware Node. Detailed information on IP addresses pools is provided in the **Configuring IP Addresses Pool** subsection.

c Select the **Enter IP addresses manually** radio button and use the **Add** button to manually set one or more IP addresses for the adapter.

- specify the IP address of the default gateway to be used by the network adapter in the **Default gateway address** field (this option is inaccessible if you select the **Obtain IP address via DHCP** radio button).

6 Click **OK** twice.

Connecting Containers to Virtual Networks

With the implementation of `veth` virtual adapters allowing Containers to function as full participants on the network, it has become possible to include Containers in a wide range of network configurations the most common of which are Ethernet networks and VLANs (virtual local area networks). The process of connecting `veth` virtual network adapters to an Ethernet network or to a VLAN is carried out using certain physical and VLAN adapters, respectively, available on the Hardware Node and involves completing the following tasks:

- creating a Virtual Network on the Node to be an intermediary between the `veth` adapters and the physical/VLAN adapter on the Node;
- connecting the `veth` virtual adapters you wish to include in an Ethernet network/VLAN to the Virtual Network;
- joining the Virtual Network where the `veth` virtual adapters are included to the corresponding physical/VLAN adapter on the Node.

After completing these tasks, the Container virtual network adapters will be able to communicate with any computer on the network (either Ethernet or VLAN) where they are included and have no direct access to the computers joined to other networks.

The process of creating new Virtual Networks and joining physical and VLAN adapters to these Virtual Network is described in the **Creating Virtual Network** (p. 212) and **Connecting Adapter to Virtual Network** (p. 210) subsections, respectively. So, in the example below we assume the following:

- The `eth0` physical adapter and the `vznetwork1` Virtual Network exist on the Hardware Node.
- The `eth0` physical adapter is connected to the local Ethernet network and to the `vznetwork1` Virtual Network.
- You wish to connect Container 101 and Container 102 to the local Ethernet network.

To join Container 101 and 102 to the local Ethernet network behind the `eth0` adapter, you should connect these Containers to the `vznetwork1` Virtual Network. This can be done as follows:

1 Find out the name of the `veth` Ethernet interfaces inside Container 101 and 102:

```
# vzlist -a -o ctid,ifname
  CTID  IFNAME
     1  -
   101  eth1
   102  eth0
   103  -
```

The command output shows that the `veth` Ethernet interfaces inside Container 101 and 102 have the names of `eth1` and `eth0`, respectively.

Note: To add a `veth` adapter to a Virtual Network, you should always use the name of its Ethernet interface inside the Container.

2 Join the `veth` adapters to the `vznetwork1` Virtual Network:

- Add the `veth` adapter of Container 101 to the Virtual Network:

```
# vzctl set 101 --ifname eth1 --network vznetwork1 --save
Saved parameters for Container 101
```

- Add the `veth` adapter of Container 102 to the Virtual Network:

```
# vzctl set 102 --ifname eth0 --network vznetwork1 --save
Saved parameters for Container 102
```

After completing these tasks, Container 101 and Container 102 will be able to access any of the servers in the network where the `eth0` physical adapter is connected.

At any time, you can disconnect the `veth` virtual network adapters of Container 101 and 102 from the `vznetwork1` Virtual Network by executing the following commands on the Node:

- To disconnect the `veth` adapter of Container 101 from the Virtual Network:

```
# vzctl set 101 --ifname eth1 --network "" --save
Saved parameters for Container 101
```

- To disconnect the `veth` adapter of Container 102 from the Virtual Network:

```
# vzctl set 102 --ifname eth1 --network "" --save
Saved parameters for Container 102
```

In Parallels Management Console, you can join a Container to any Virtual Network on the Hardware Node by performing the following operations:

1 Choose the **Virtuozzo Containers** item under the corresponding Hardware Node name, right-click the Container you wish to join to the Virtual Network, and select **Properties** on the context menu.

2 On the **Network** tab of the displayed window, select the **Network Adapters** item.

3 Double-click the Container virtual network adapter to be connected to the Virtual Network.

4 In the **Virtual Network Interface Properties** window, under **Virtual Network**, select the **Connect to** radio button and, on the drop-down menu, choose the needed Virtual Network:

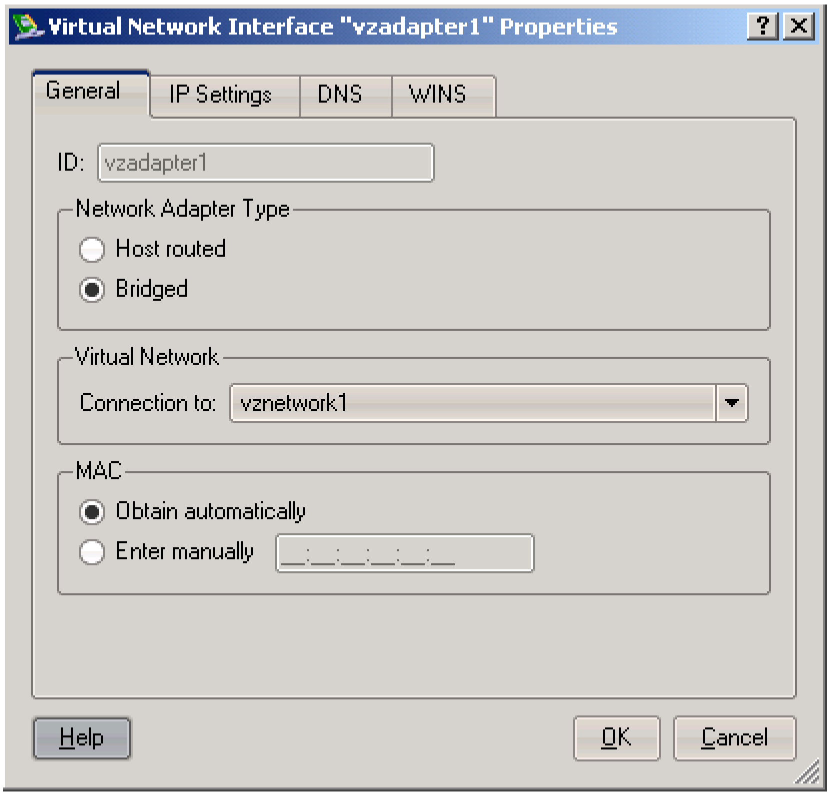


Figure 76: Mannagement Console - Connecting veth Adapter to Bridge

5 Click OK twice.

To remove a Container virtual network adapter from the Virtual Network where it is currently included, perform Steps 1-3 described above and, in the Virtual Network Interface Properties window, select `Not Connected` on the drop-down menu.

Note: If you are deploying Virtuozzo Containers 4.0 in a VMware ESX Server environment, you should perform the following operations to make your Containers operating in the `veth` mode accessible from external servers:
- Make sure that the value of the Promiscuous Mode field on the Security tab of the vSwitch Properties window is set to `Accept`.
- Ensure that the ESX Server adapter always has one and the same MAC address assigned.

C H A P T E R 8

Managing Hardware Nodes

The current chapter centers on all those operations you can perform on your Hardware Nodes. You will learn how to manage your Virtuozzo licenses, to unite your Nodes into a group, to view and configure a number of Virtuozzo-related parameters.

In This Chapter

Managing Virtuozzo Licenses.. 227
Managing Files.. 235
Managing IP Addresses Pool on Node.. 242

Managing Virtuozzo Licenses

The given section provides information on managing Virtuozzo licenses. In particular, you will know how to view the current license status, to install a new license on your Hardware Node or to update an existing one, to transfer the license from one Node to another, etc.

Installing Virtuozzo Server License

Depending on the way you have obtained your Virtuozzo Server license, it can be installed on the Hardware Node as follows:

- If you have obtained the Virtuozzo Server license in the form of a product key, you can install it on the Node using the `-p` option of the `vzlicload` command. For example, you can execute the following command to install the `5BVMF2-560MM0-D28DQA-B59NTE-10H4HG` product key on your Hardware Node:

```
# vzlicload -p 5BVMF2-560MM0-D28DQA-B59NTE-10H4HG
Processing product key "5BVMF2-560MM0-D28DQA-B59NTE-10H4HG"...
License VZSRV was loaded successfuly
---
 1 of 1 licenses was loaded
```

- If you have obtained the Virtuozzo Server license in the form of an activation code, you can install it on the Node using the `-a` option of the `vzlicupdate` command. For example:

```
# vzlicupdate -a 5K4N96-05WRT4-P28A4R-M65W3T-VB4A7C
```

  where `5K4N96-05WRT4-P28A4R-M65W3T-VB4A7C` is the Virtuozzo activation code. When executed, `vzlicupdate` connects to the Parallels Key Authentication (KA) licensing server and transmits the specified activation code there. In its turn, the licensing server generates a license file, sends it back to the Hardware Node from where the activation code has been dispatched, and installs it on this Node. So, before executing the aforementioned command, it is necessary to make sure that the Hardware Node is connected to the Internet.

In Parallels Management Console, you can install a Virtuozzo Server license (using both a product key and an activation code) by doing the following:

1 Follow the Manage License link at the Hardware Node dashboard.

2 In the Manage Licenses window, click the Install License button.

3 In the Choose License Installation Method window, select the Enter a new Virtuozzo license key radio button and click Next:

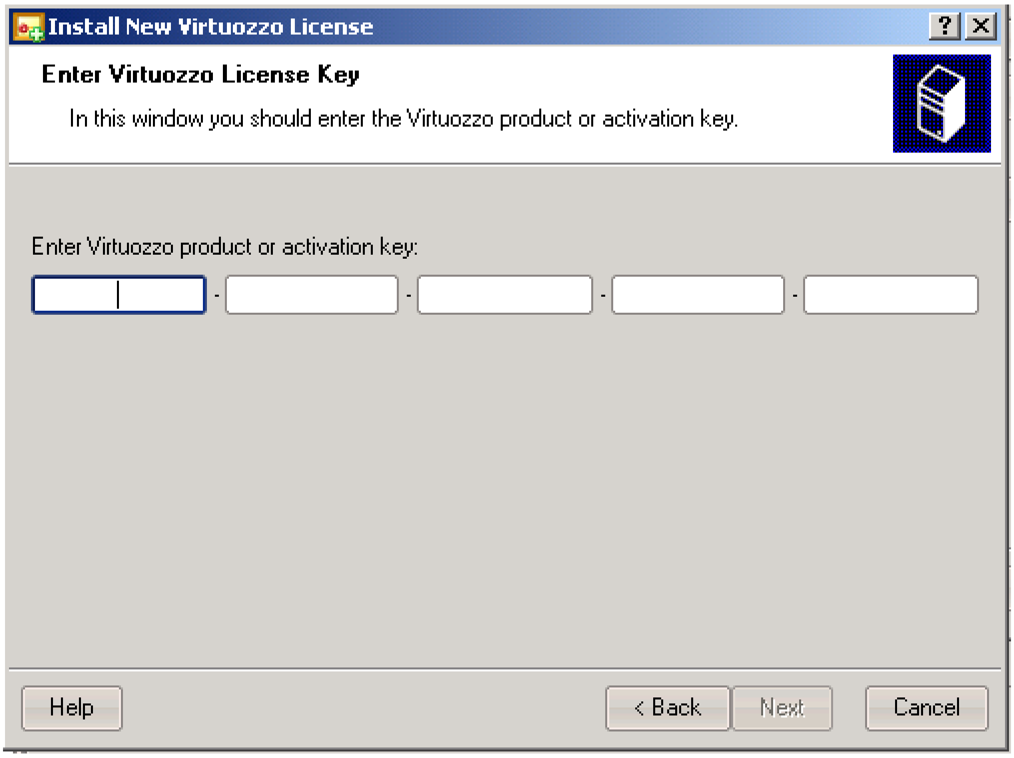


Figure 77: Management Console - Installing License on Hardware Node

4 Enter the Virtuozzo Server product key number or the activation code in the field provided and click Next.

5 In the Review License Details window, you can view detailed information on the license that will be installed on your Node. Click the Install button to initiate the installation process.

If you are activating your Virtuozzo Containers installation by means of an activation key, you should have an active Internet connection to successfully complete the Virtuozzo license installation. Otherwise, you will be presented with the corresponding warning message informing you of the steps you have to take to activate your license. As a rule, these steps include the following:

1 Visiting the http://www.swsoft.com/en/support/virtuozzo/activate web page and activating the Virtuozzo license manually.

2 Providing the following information on this web page:

- In the Product Code field, specify your license activation code (e.g. `A6C400-WT1321-PFHB48-VIPG61-PDRT56`).
- In the HWID field, provide the ID of your Hardware Node. You can find this ID in the Parallels Management Console warning message displayed after clicking the Install button in the Review License Details window.

3 Clicking the **Activate License** button.

If you have entered the correct information on the **Virtuozzo License Activation** page, you will be provided with a link to a Virtuozzo license file that you should download to and install on the Hardware Node to start using Virtuozzo Containers 4.0. To install the obtained Virtuozzo license file on the Node, do the following:

- Running the `vzlicload` utility with the `-f` option on the Hardware Node where the license file is to be loaded. For example:

```
# vzlicload -f /etc/vzlicense
```

  This command will install the license file with the name of `vzlicense` on your Node.

- Using Parallels Management Console:

1 Follow the **Manage License** link at the Hardware Node dashboard.

2 In the **Manage Licenses** window, click the **Install License** button.

3 Select the **Upload the Virtuozzo license file** radio button in the **Choose License Installation Method** window and click **Next**:

4 In the **Specify Virtuozzo License File** window, you can do one of the following:

  - enter the path to the license file in the field provided or use the **Browse** button to specify the location of the license file or
  - select the **Paste the license text in the area below** radio button and copy the contents of the license file in the field at the bottom of the window.

  When you are ready, click **Next**.

5 In the **Review License Details** window, you can view detailed information on the license that will be installed on your Node. Click the **Install** button to upload the license to the Hardware Node and install it there.

Updating License

The `vzlicupdate` utility shipped with Virtuozzo Containers 4.0 allows you to update the Virtuozzo Server license currently installed on the Hardware Node. When executed, the utility tries to connect to the Parallels Key Authentication (KA) server and to retrieve a new license in order to install it on the Node. So, before starting to use this utility, you should make sure that the Hardware Node where you wish to update the Virtuozzo license is connected to the Internet. After that, you can issue the following command to update your Virtuozzo license:

```
# vzlicupdate
Start updating license [6E62.3D01.6BEC.E8D7.CE42.4517.68CB.E102]
...
```

By default, `vzlicupdate` tries to access the KA server having the hostname of `ka.swsoft.com`. However, you can explicitly specify what KA server is to be used by passing the `--server` option to the utility:

```
# vzlicupdate --server ka.server.com
```

In this case the `vzlicupdate` utility will try to connect to the KA server with the hostname of `ka.server.com`, to get a new license from this server, and to install it on the Hardware Node where `vzlicupdate` has been executed.

Note: In the current version of Virtuozzo Containers, you can update Virtuozzo licenses installed on the Hardware Node with the help of activation code only. If you wish to update a Virtuozzo Server product key installed on your Node, please contact a Parallels sales representative to learn how you can do it.

To update a Virtuozzo Server license in Parallels Management Console, do the following:

1 Make sure that the workstation where Management Console is installed and the Hardware Node where you are planning to update the license are connected to the Internet.

2 Follow the **Manage License** link at the Hardware Node dashboard.

3 In the **Manage Licenses** window, click the **Update License** button. Management Console will try to connect to the Parallels Key Authentication (KA) server, retrieve a new license, and install it on the Node.

Transferring License to Another Node

Sometimes you may wish to transfer Virtuozzo licenses from one Hardware Node (*Source Node*) to another (*Destination Node*). For example, this may be the case if the Node where the Virtuozzo Server license is installed starts experiencing problems for some reason or other or requires the hardware upgrade.

The procedure of transferring a Virtuozzo license from one Hardware Node to another depends on the license type and can be one of the following:

- If you have activated your Virtuozzo Containers installation by means of a Virtuozzo Server product key, you can transfer the installed license from the Source to the Destination Node as follows:
  - Remove the installed license from the Source Node (e.g. using the `vzlicload -r` *`product_key`* command);

- Log in to the Destination Node;
- Install the Virtuozzo Server product key on the Destination Node. Detailed information on how to install Virtuozzo licenses is provided in the **Installing License on Hardware Node** subsection (p. 227).

- If you have activated your Virtuozzo Containers installation by means of a Virtuozzo activation code, you should use the `vzlicupdate` utility to move Virtuozzo Server licenses between Hardware Nodes. For example, to transfer a Virtuozzo license that has been installed on Node 1 using the `9BVMF2-560MN0-F28DQA-O59NTE-12H6HG` activation code to Node 2, you should do the following:

1. Ascertain that Node 1 is shut down or the license is removed from this Node.
2. Make sure that Node 2 is up and connected to the Internet.
3. Log in to Node 2 (e.g. via `ssh`).
4. Execute the following command on Node 2:

```
# vzlicupdate -t -a 9BVMF2-560MN0-F28DQA-O59NTE-12H6HG
```

When executed, `vzlicupdate` sends the `9BVMF2-560MN0-F28DQA-O59NTE-12H6HG` license key to the Parallels KA server, thus informing the server of its intention to transfer the license to a new Hardware Node. The KA server verifies the received license key, generates a new license file, sends it back to Node 2, and installs it there.

To transfer a Virtuozzo license from the Source Node to the Destination Node in Management Console, perform the following operations:

- Ascertain that the Source Node is shut down or the license is removed from this Node.
- Make sure that the Destination Node and the computer where Management Console is installed are connected to the Internet.
- In Management Console, click the Destination Node name and follow the **Manage License** link at the Hardware Node dashboard.
- In the **Manage Licenses** window, click the **Install License** button.
- Select the **Transfer a license from another Hardware Node** radio button in the **Choose License Installation Method** window and click **Next**.
- In the **Enter Product Activation Code** window, enter the activation code and click the **Install** button. Management Console will connect to the Parallels KA server, inform the server of its intention to transfer the license to a new Hardware Node, get a new license file from the KA server, and install it on the Destination Node.

You can check that the license transferal has completed successfully by means of the `vzlicview` utility. For example, to check that the `U8IK3F-P6QJ8A-O59NTE-42H6HL-D5R07H` product key is now installed on Node 2 (see the example above), issue the following command:

```
# vzlicview
Show installed licenses...
VZSRV
        status="ACTIVE"
        version=4.0
        serial="9BVMF2-560MN0-F28DQA-O59NTE-12H6HG"
        expiration="05/01/2007 23:59:59"
         ...
```

The command output shows that the `9BVMF2-560MN0-F28DQA-O59NTE-12H6HG` license key has been successfully installed on Node 2 and you can start using the Virtuozzo Containers software on this Node. Detailed information on the `vzlicview` utility and its output is provided in the Viewing Current License subsection (p. 232).

Viewing Current License

The given subsection familiarizes you with the way to view the information on the Virtuozzo licenses currently installed on your Hardware Node.

Viewing Virtuozzo Server License

In order to view the information on the Virtuozzo Server license and find out its current status, Parallels ships a special `vzlicview` utility. When executed, this utility checks the Virtuozzo Server license currently installed on the Hardware Node and prints the license contents along with its status obtained from the kernel. A sample output of `vzlicview` is given below:

```
# vzlicview
Show installed licenses
VZSRV
        status="ACTIVE"
        version=4.0
        serial="6BWMF2-560MM0-D28DQA-C59NTE-10H6HG"
        expiration="12/01/2006 23:59:59"
        graceperiod=86400 (86400)
        key_number="VZ.00000001.0000"
        cpu_total=64 (1)
        ct_total=8200 (1)
        max_vzmcpmc_users=128
        max_pim_users=260
        platform="Any"
        product="Virtuozzo Containers"
        vzpp_allowed=1
        backup_mgmt_allowed=1
        workflow_mgmt_allowed=1
        vzagent_allowed=1
        architecture="Any"
```

The command output shows the full information about the Hardware Node license. The main Virtuozzo Server license parameters which may be of interest to you are listed in the following table:

Column Name	Description
`status`	The status of the license currently installed on the Hardware Node. The information on all license statuses is provided in the Virtuozzo License Statuses subsection (p. 234).
`version`	The Virtuozzo Containers version with which the license is compatible.
`serial`	The Virtuozzo Server license serial number.
`expiration date`	The license expiration date, if it is time-limited.
`grace_period`	The period during which Parallels Virtuozzo Containers continues functioning after your license has expired, in minutes.
`key_number`	The number under which the Virtuozzo Server license is registered on the Parallels Key Authentication server.
`cpu_total`	The total number of central processor units (CPUs) which can be installed on the Hardware Node.
`ct_total`	The total number of Containers which can simultaneously run on the Hardware Node.
`max_vzmc_users`	The number of users able to simultaneously connect to the Node through Parallels Management Console.
`max_vzcc_users`	The number of users able to simultaneously connect to the Node through Parallels Infrastructure Manager.
`platform`	The operating system with which the license is compatible.
`product`	The product name for which the license has been issued.

`vzpp_allowed`	Indicates whether you can manage Containers residing on the given Hardware Node by means of Parallels Power Panel: ▪ `1`: the 'Parallels Power Panel' functionality is enabled; ▪ `0`: the 'Parallels Power Panel' functionality is disabled.
`backup_mgmt_allowed`	Indicates whether the 'backup' functionality is enabled for the given Hardware Node: ▪ `1`: the 'backup' functionality is enabled; ▪ `0`: the 'backup' functionality is disabled.
`workflow_mgmt_allowed`	Indicates whether the 'Container requesting' functionality is enabled for the given Hardware Node: ▪ `1`: the 'Container requesting' functionality is enabled; ▪ `0`: the 'Container requesting' functionality is disabled.
`vzagent_allowed`	Indicates whether you are allowed to use the Parallels Agent functionality on the given Hardware Node: ▪ `1`: the Parallels Agent functionality is enabled; ▪ `0`: the Parallels Agent functionality is disabled.
`architecture`	The system architecture with which the license is compatible.

In Parallels Management Console, you can check the current status of the Virtuozzo Server license installed on the Hardware Node by doing the following:

1 Follow the **Manage License** link at the Hardware Node dashboard.

2 Choose **Virtuozzo Server license** in the top part of the **Manage Licenses** window. The full information about the installed Virtuozzo Server license will be displayed in the **License details** table in the bottom part of the window.

Virtuozzo License Statuses

When viewing information on your license, please pay special attention to the license status that can be one of the following:

ACTIVE	The license installed on the Hardware Node is valid and active.
VALID	The license the utility parses is valid and can be installed on the Hardware Node.
EXPIRED	The license has expired and, therefore, could not be installed on the Hardware Node.
GRACED	The license has been successfully installed on the Hardware Node; however, it has expired and is currently on the grace period (i.e. it is active till the end of the grace period).
INVALID	The license is invalid (for example, because of the Hardware Node architecture mismatch) or corrupted.

Managing Files

Parallels Management Console provides you with a special file manager allowing you to perform various operations on files and folders located on the Hardware Node. You can access the file manager by clicking the **File Manager** item under the corresponding Hardware Node name. After expanding the **File Manager** item, you will see a list of directories available on the Hardware Node:

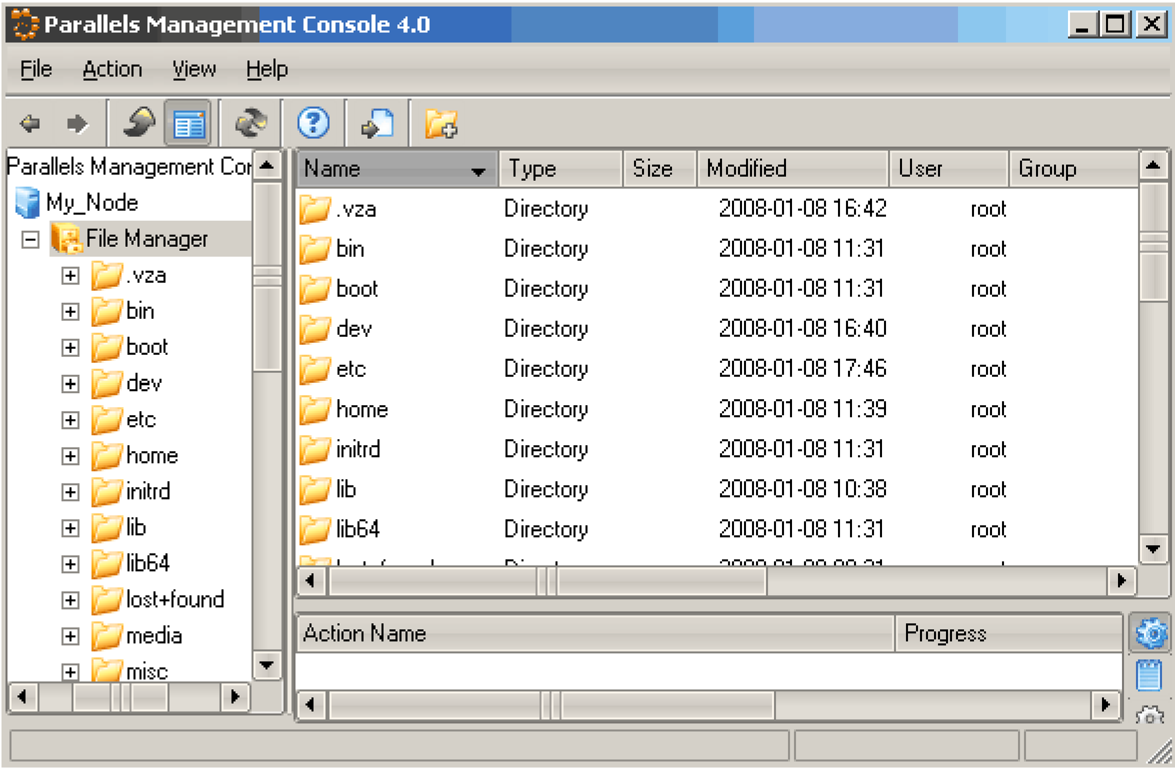


Figure 78: Management Console - Managing Files on Node

The principles of working with the Hardware Node file manager are standard. You can move through the hierarchy of directories by double-clicking their names or selecting the necessary directories in the left pane. Use the menu items, toolbar buttons, table view, and context menus to perform the following tasks:

- View the contents of simple text files;
- View the principal information about a file/directory available on the Hardware Node;
- Upload any number of files or whole directories from your local computer (the computer where Management Console is installed) to any directory on the Hardware Node;
- Download any number of files from the Hardware Node to your local computer;
- Create new directories on the Hardware Node;
- Copy files to another directory on the Hardware Node;
- Move files to another directory on the Hardware Node;
- Delete files/directories from the Hardware Node;
- Rename files/directories on the Hardware Node;

- Set permissions for Container files.

Parallels Management Console provides a user-intuitive interface for performing all these tasks.

Uploading Files to Node

In Parallels Management Console, you can upload any number of files or whole directories from the local computer (the computer where Management Console is installed) to any directory on the Hardware Node. Under the corresponding Hardware Node name, right-click the File Manager item and select Tasks --> Upload Local File(s) on the context menu. The Upload Files Wizard opens:

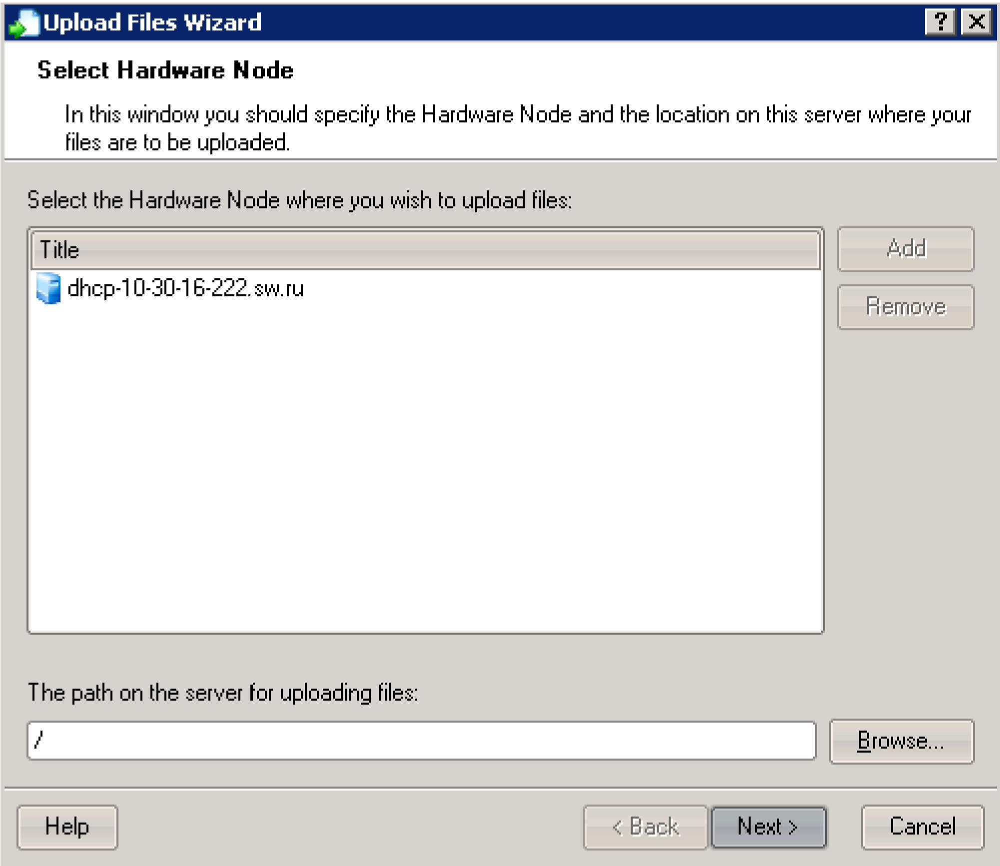


Figure 79: Management Console - Choosing Hardware Nodes for Uploading Files

It is a four-step wizard. On the first step of the wizard, you should define the Hardware Node(s) and the path on this Node (these Nodes) where the files will be uploaded. Click the Add button to open the Select Hardware Node(s) window and select the Hardware Node you wish to add to the upload list. Repeat this sequence for every Hardware Node where you wish to upload files and then click OK. After that, you should enter the path where the files are to be uploaded or browse for this path on the remote Node. Click Next when you are finished.

On the second step of the wizard, you should specify the local files you wish to upload to the Hardware Node(s) that you specified on the previous step.

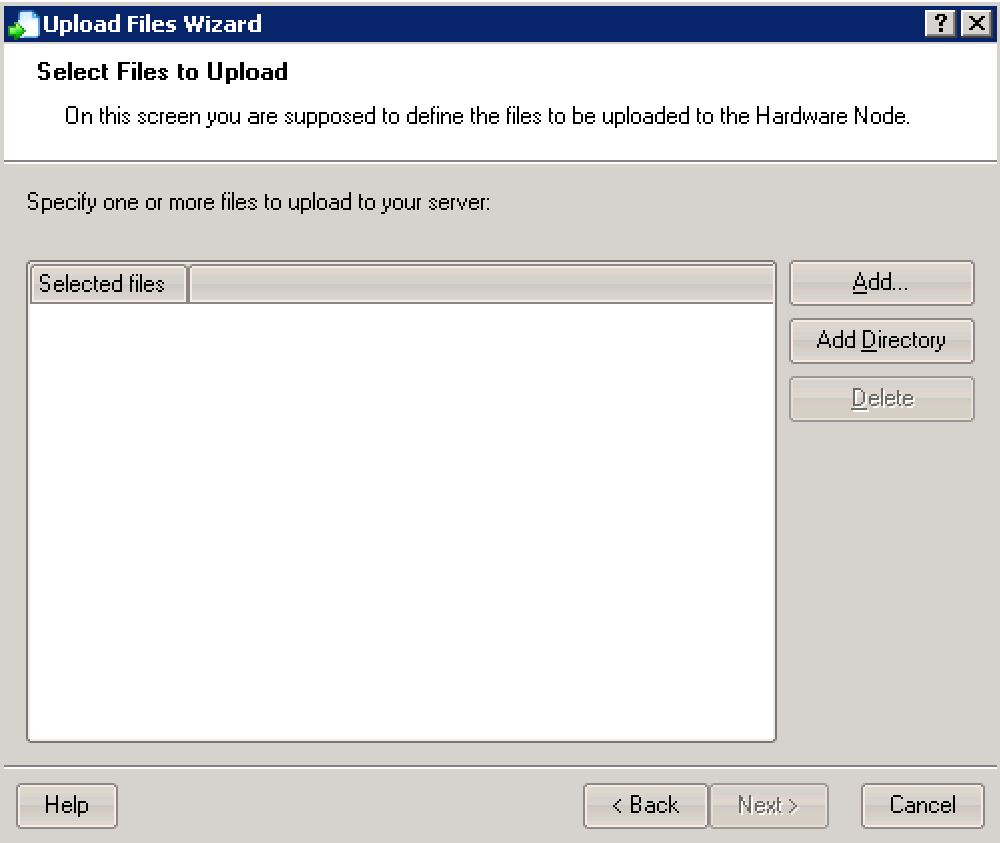


Figure 80: Management Console - Uploading Files to Hardware Node

On the first step of the wizard, you should specify the local files you wish to upload to the Hardware Node. Click the Add button and select a file or a group of files from a single directory for uploading. You can also upload the whole directory by clicking the Add Directory button. If you need to upload files from various local directories, click the Add button the required number of times. After you have added all the files and directories to be uploaded, click Next.

The second step of the wizard allows you to specify file access permissions, i.e. to set up certain attributes of the files to be uploaded:

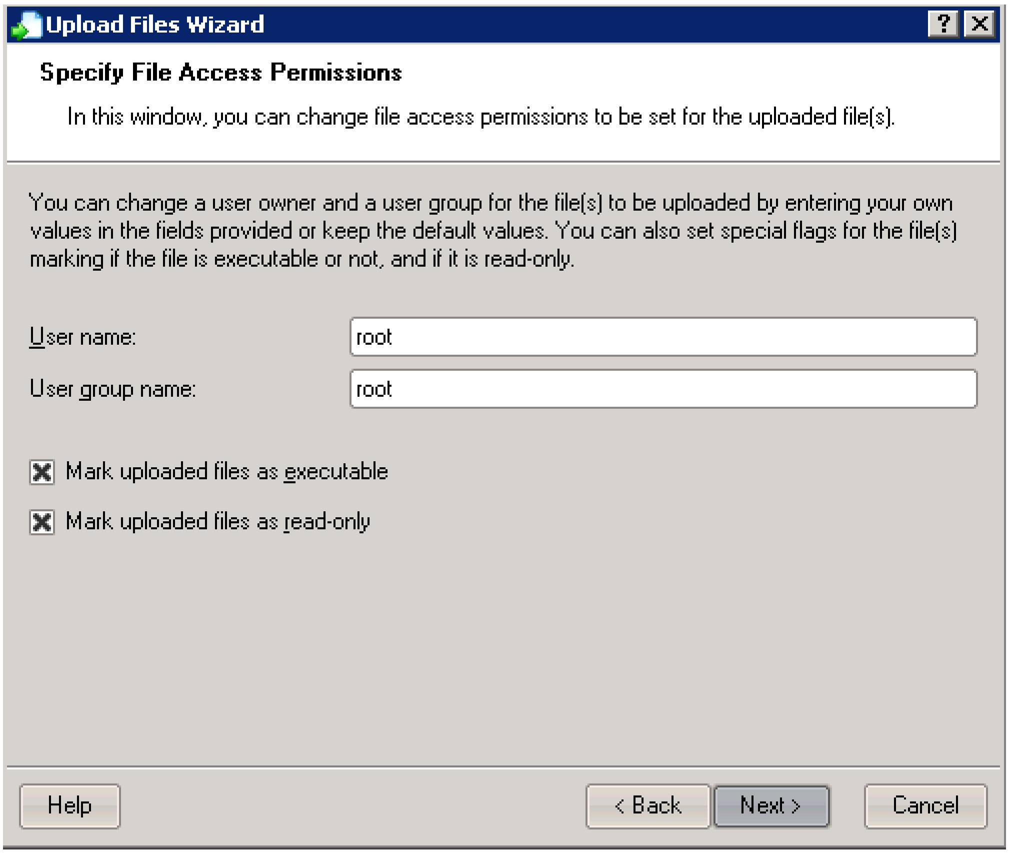


Figure 81: Management Console - Uploading Files to Hardware Node

Each file in any Unix system must have a user owner and a user group. The default values are `root` in both cases. You may specify your own values in the fields provided. A file has also special flags marking if the file is executable or not, and if it is read-only. Depending on your choice, the files may be uploaded with any values of these attributes. Review the settings, make the necessary corrections, and click **Next**.

The next window lets you review all the information provided by you on the previous steps of the wizard. Make sure the settings are correct. To change the settings, click the **Back** button and make the necessary corrections. After you click **Next**, the uploading process begins. The operation progress is graphically displayed in the window of the **Upload Files Wizard**. You can see how each of the selected files is being consecutively uploaded to the Hardware Node. Please wait for the operation to finish.

After the uploading process has finished, you will get informed of the results of the operation. The table in the displayed window lets you view the results regarding every file uploaded to the Node. Click **Finish** to exit the wizard.

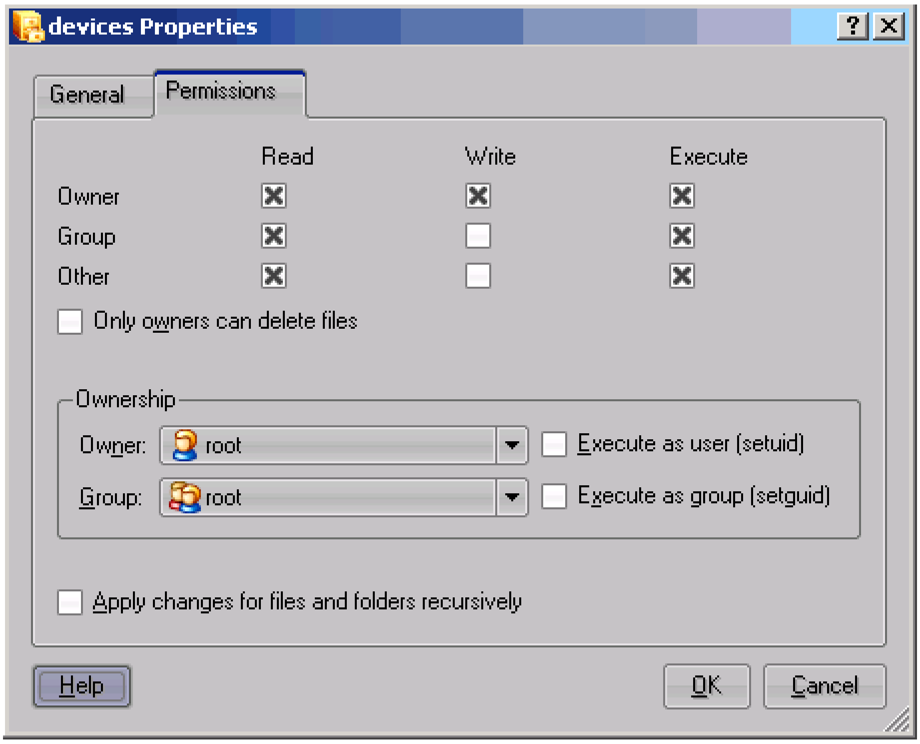
Downloading Files to Local Computer

Parallels Management Console allows you to download any file or directory located on the Hardware Node to the computer where Management Console is installed. To this effect, do the following:

1. Expand the **File Manager** item under the corresponding Hardware Node name.
2. Select the file/directory you wish to download to your local computer (you can use CTRL+Click to select or deselect the file/directory, SHIFT+Click to select a range of files/directories, CTRL+A to select all files/directories).
3. Right-click it and choose **Tasks --> Copy To Local Computer** on the context menu.
4. In the displayed window, specify the directory where you wish to download the selected file/directory.
5. Click **OK**.

Setting Permissions for Files on Node

Parallels Management Console allows you to view and/or change the properties of the corresponding file or directory on the Hardware Node. Under the corresponding Hardware Node name, expand the **File Manager** item, select the file/directory whose properties you wish to display, right-click it, and choose **Properties**. The file/directory **Properties** window opens:



The information is presented on two tabs:

- **General**: This tab contains only one editable field (**Name**) where you can rename the current file or directory. You can also view the type, location, size, and the last modification date of the file or directory.
- **Permissions**: This tab allows you to set the owner and the group for the corresponding file/directory and its standard Unix properties.

  If you are working with a directory, there are two other options on the tab. They are described in the table below:

Option	Description
Only owners can delete files	This option is used to override the **Write** permission when it is given to **Group** or **Other**. If this is the case, selecting this check box will allow the **Group** and **Other** members only to write the files in the corresponding directory, but not to delete them.
Apply changes for files and folders recursively	If you select this check box, the changes in ownership and permissions that you have made for the current directory, will be recursively applied to all its subdirectories and files.

Managing IP Addresses Pool on Node

The given section provides information on how you can manage IP addresses pools for your Hardware Nodes.

Configuring Hardware Node IP Addresses Pool

After you have registered a Hardware Node in Parallels Management Console, you can create and configure the IP addresses pool for Containers which will be hosted on this Node. This helps you ensure a unified space of Container IP addresses within your Hardware Node.

To create a new IP addresses pool or configure an existing one, do the following:

1. Right-click the corresponding Hardware Node name and select **Network Configuration --> IP Addresses Pool** on the context menu:

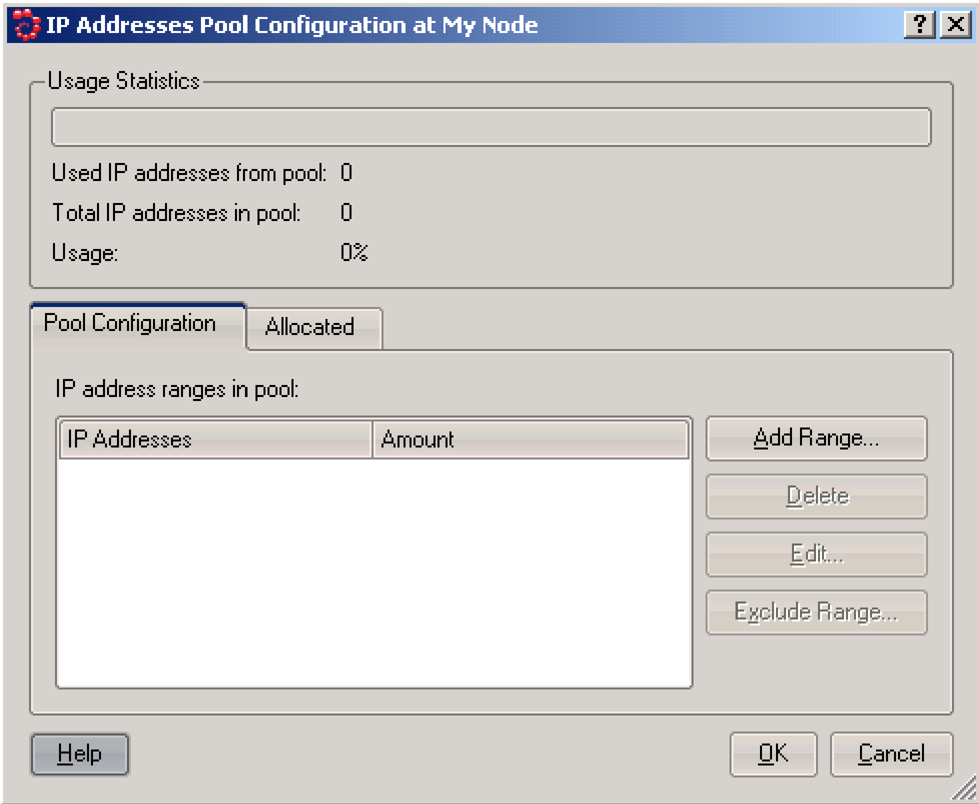


Figure 82: Management Console - Configuring Node IP Addresses Pool

2. On the **Pool Configuration** tab of the **IP Addresses Pool Configuration** window, use the provided buttons to make a new pool or configure an existing one. Pools are comprised of continuous ranges of IP addresses. Every range may be characterized by the starting IP address, the ending IP address, and the number of IP addresses within the range. Obviously, it is enough to know any two of these three parameters to deduce the third one. The information on the operations you can perform using the buttons to the right of the **IP address ranges in pool** table is presented below:

Button	Description
Add Range	Displays a window where you can define a new range for the IP addresses pool of the given Hardware Node.
Delete	Deletes the IP addresses range selected in the table.
Edit	Displays a window where you can edit the parameters of the range selected in the table.

Exclude Range	Displays a window where you can exclude a certain continuous subrange of IP addresses from the range selected in the table. As a rule, this brings about the appearance of two new ranges instead of the selected one.

Viewing Allocated IP Addresses

Parallels Management Console allows you to view the IP addresses from the pool that were already assigned to the Containers on your Hardware Node (either during the Container creation or while configuring these Containers afterwards). To this effect, you should right-click the corresponding Hardware Node name, select **Configure IP Addresses Pool** on the context menu, and go to the **Allocated** tab of the displayed window:

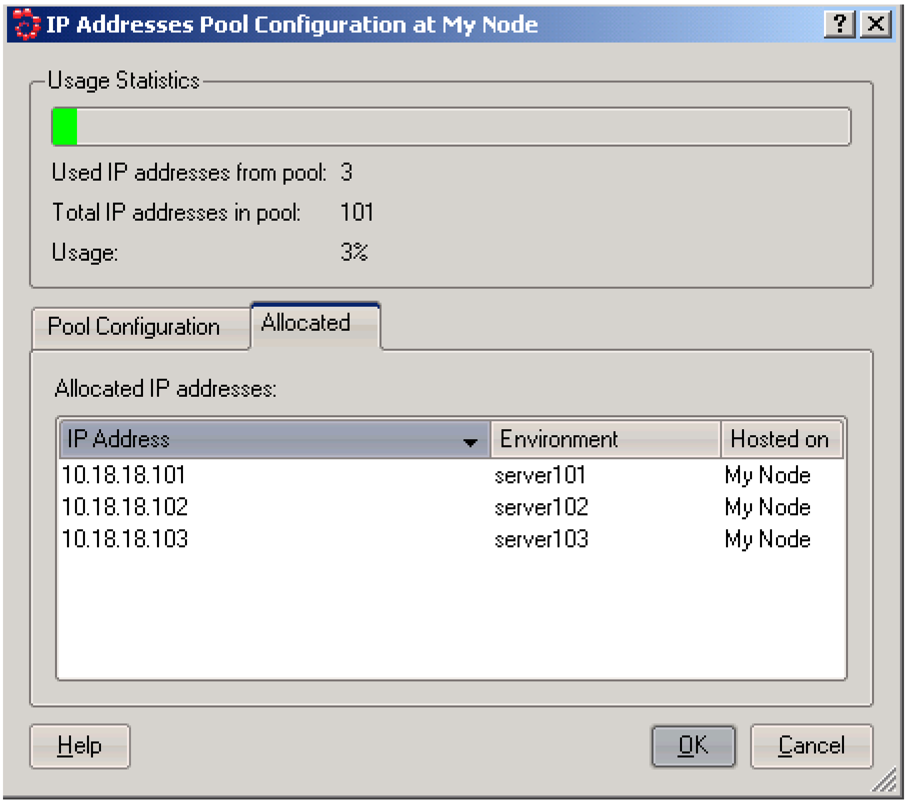


Figure 83: Management Console - Viewing Information on IP Addresses Pool

In this window you can view the following information about your IP addresses pool:

- Under the **Usage Statistics** group, you can learn:
  - the number of IP addresses from the pool already assigned to the Containers on the Node;
  - the total number of IP addresses in the pool;
  - the ratio of used IP addresses to the total number of IP addresses in the pool, in percent; the graphical representation of this ratio is also provided at the top of the **IP Addresses Pool Configuration** window.

- The **Allocated IP addresses** table provides detailed information on the IP addresses already allocated to the Containers on the Hardware Node:

Column Name	Description
IP Address	The IP address from the pool already allocated to some Container on the Node.
Environment	The hostname of the Container to which the IP address was allocated.
Hosted on	The name of the Hardware Node where the database of IP addresses (the IP addresses pool) is stored.

C H A P T E R 9

Keeping Your Virtuozzo System Up-to-Date

Being a virtualization solution, the Virtuozzo Containers software modifies the host operating system on a rather low level, even including kernel modification. With this in mind, the Virtuozzo Hardware Node administrator is supposed to understand what are the ways to keep the Virtuozzo system up-to-date by applying all the latest security fixes and other updates.

The components to be kept up-to-date are the following:

- the Host OS software;
- the Virtuozzo Containers software, and
- the Containers created on the Hardware Node.

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Updating Host OS Software

Beginning with Virtuozzo Containers 3.0, it is safe to use the native Linux distributions updaters (`up2date`, `yum`, or `yast`) in the same way as you would use them on common non-Virtuozzo systems. This is due to the fact that the Virtuozzo Containers installation program modifies the settings of these updaters in such a way that the kernel and other packages vital for Virtuozzo Containers 4.0 functioning do not get updated, unlike all the other operating system packages. The Hardware Node administrator should regularly use these updaters without overriding their default behavior, which ensures that the non-Virtuozzo-specific part of the operating system has all the latest fixes (including security patches) installed and that Virtuozzo-specific packages are not erroneously updated by native updaters. If a security patch or other fix is issued for the mainstream Linux kernel or any other package that has been modified for Virtuozzo needs, the kernel/package is instantly rebuilt by Parallels with this security patch and becomes accessible on the Virtuozzo Containers update site (see the Updating Virtuozzo Containers Software section below).

There follows a description of peculiarities of various native updaters and their integration with Parallels Virtuozzo Containers.

Using up2date

The up2date updater can be used on such host operating systems as Red Hat 9, Red Hat Enterprise Linux 4 and 5, CentOS 4 and 5, Fedora 7 and 8.

If Parallels Virtuozzo Containers is installed on the server, the /etc/sysconfig/rhn/up2date configuration file is modified in such a way so as to let all the packages necessary for Virtuozzo Containers 4.0 functioning remain intact on the Node during the work of up2date.

So, here are the pitfalls you should avoid while using the up2date updater:

- Do not modify the value of the following parameters in the /etc/sysconfig/rhn/up2date configuration file:
  - pkgSkipList;
  - removeSkipList;
  - forceInstall (the right value is 0);
- Do not pass the -f or --force option to up2date.

Using yum

The yum updater can be used on such host operating systems as CentOS 4 and 5, Fedora Core 5, 6, Fedora 7 and 8.

If Virtuozzo Containers 4.0 is installed on the server, the /etc/yum.conf configuration file is modified in such a way so as to exclude all the packages necessary for Virtuozzo Containers 4.0 functioning from the update list. The parameter the value of which you should avoid modifying in this configuration file is exclude, which is located in the [main] section. You should not use other configuration files than the default one, either.

Using yast

The yast updater can be used on the SUSE Linux Enterprise Server 9 host operating system. The default behavior of this updater does not update any packages that are not signed by SUSE. All the packages on a SLES 9 distribution that have been replaced with analogous ones by Parallels (including the kernel) do not have the SUSE signature and thus are excluded from the default update list. However, it is very easy to inadvertently override this default behavior (a casual mouse-click opposite an Parallels-rebuilt package could be enough), so you should be extra careful with yast.

Updating Virtuozzo Containers Software

Parallels Virtuozzo Containers for Linux is constantly developing: there appear new versions of the Virtuozzo core and of existing Virtuozzo utilities, OS and application templates are perfected, new templates and utilities are also added from time to time. Thus, Parallels Virtuozzo Containers as a single product may often be repackaged to include the latest changes in any of its parts. As these changes grow in number, new Virtuozzo Containers versions with incremented major and/or minor numbers are released.

Parallels Virtuozzo Containers allows you to use one of the following tools to update your Virtuozzo Containers software:

- the `vzup2date` utility;
- Parallels Management Console.

You can use both tools to connect to the Virtuozzo update server and update the following components on the Hardware Node:

- the kernel;
- the Linux packages copyrighted by third parties (by the OS vendor, for example) but built by Parallels for compatibility with Virtuozzo Containers 4.0; such packages are usually rebuilt by Parallels and put on the Virtuozzo update server after a security or other important hotfix is issued by the third party;
- the Virtuozzo packages copyrighted and built by Parallels, Inc.;
- the Virtuozzo templates (both standard and EZ) installed on the Hardware Node.

Updating Parallels Virtuozzo Containers With vzup2date

The `vzup2date` utility, introduced in Virtuozzo Containers 2.6.1, is intended to relieve Virtuozzo administrators of the necessity to manually update existing Virtuozzo Containers installations. It provides a single information channel for learning if updated Virtuozzo Containers versions are available. In other words, a regular launching of this utility helps ensure that you always have the latest Parallels Virtuozzo Containers software available.

The `vzup2date` utility can be launched in two modes:

- Graphical mode representing the **Virtuozzo Update** wizard allowing you to update either the Virtuozzo system files or the Virtuozzo templates depending on the options passed to `vzup2date`.
- Command line mode containing two submodes:
  - the batch submode and
  - the messages submode.

  In comparison to the graphical mode, the command line mode provides more inclusive possibilities for the Virtuozzo Containers updates management (e.g. the ability to use special filters while selecting updates for your system).

Both modes are described in the following subsections in detail.

Updating in Graphical Mode

In the graphical mode, the `vzup2date` utility can be launched in three submodes. If invoked without any parameters or with the `-s` switch, it is supposed to check and, if necessary, download and install Virtuozzo system files, i.e newest versions of the Virtuozzo core and utilities. On the other hand, the `-t` and `-z` switches provided when invoking the utility tells it to perform the same operations for Virtuozzo OS and application standard and EZ templates, respectively. There is no single interface for checking Virtuozzo system files and templates at once, as these operations are different in nature, so you should consecutively call the `vzup2date` utility with and without the `-t` and `-z` switches, if you wish to check for all available system and template updates.

Note: You can explicitly specify that the `vzup2date` utility is to be run in the graphical mode by passing the `-m interactive` switch to it.

The `vzup2date` utility is implemented as a wizard, the first few steps of which are common for all three modes. After you launch the utility from the command line, you will be presented with a greeting screen:

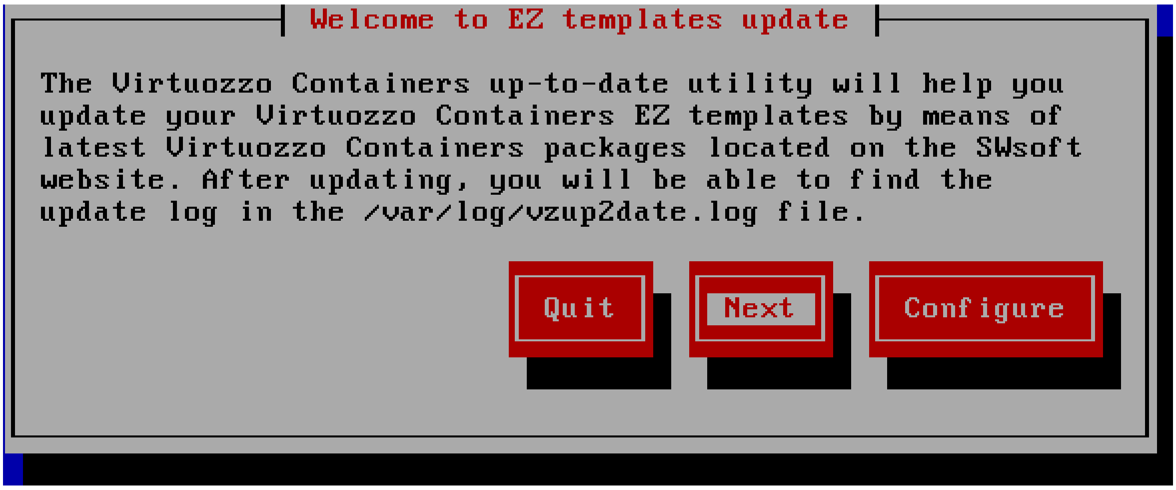

Figure 84: Updating Virtuozzo Containers - Welcome Screen

In this window you can do one of the following:

- Click the **Next** button to connect to the Parallels default repository
- Click the **Configure** button to display the current settings used to connect to the repository housing Virtuozzo updated packages and templates and to configure it, if necessary:

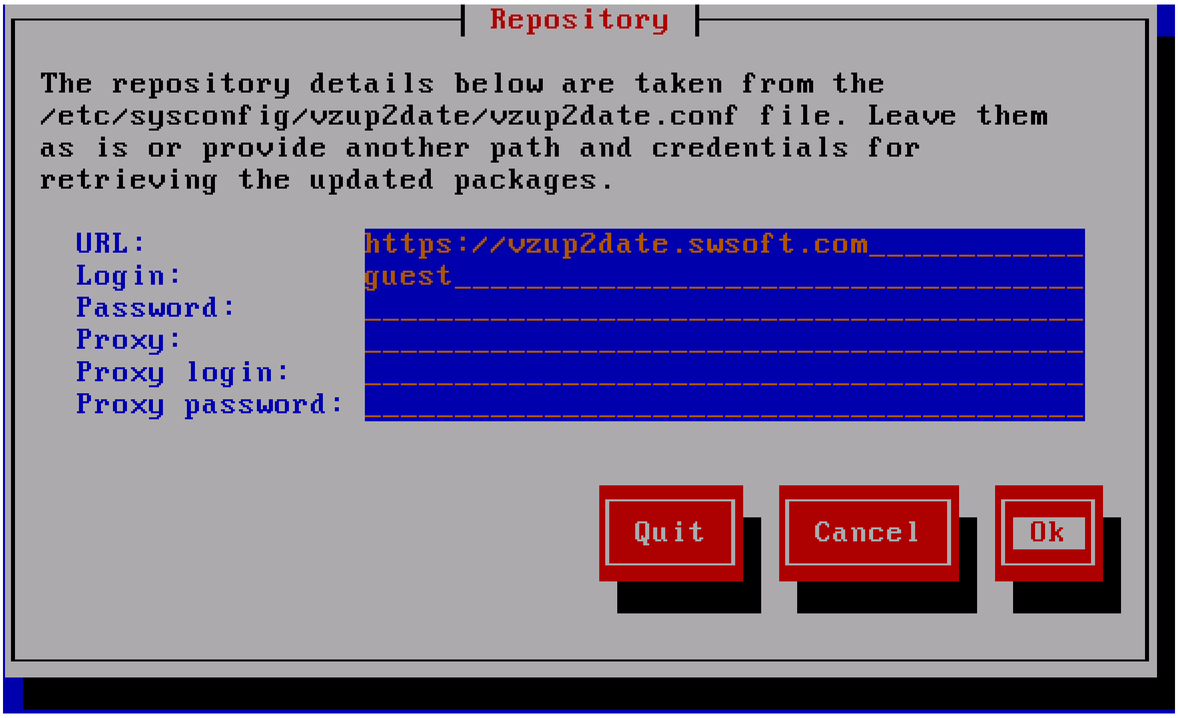

Figure 85: Updating Virtuozzo Containers - Specifying Repository

The information on this screen is taken from the `/etc/sysconfig/vzup2date/vzup2date.conf` file on the Hardware Node. If you wish to change this information and save the changes to the configuration file, enter the correct settings into the fields provided and press **OK**. For example, this may be the case if you have created your own local mirror of the Virtuozzo official repository with the `vzup2date-mirror` utility. For detailed information on `vzup2date-mirror`, please turn to the **Creating Local Repositories for vzup2date** section (p. 332).

As soon as you press **Next** in the **Welcome...** window, the utility will try to connect to the specified repository (either the Parallels default repository or your own one) and, if the connection is successful, display the next screen, which will vary depending on the mode of the `vzup2date` invocation. First, we will describe the mode of updating Virtuozzo system files and then proceed with updating Virtuozzo standard and EZ templates.

Updating Virtuozzo System Files

After the repository is checked for updates availability, it may happen that no updates are available for your system, in which case the utility will duly inform you thereof. If there are any updates, please distinguish between major and minor Virtuozzo Containers updates. A major Virtuozzo Containers update is indicated by a higher version of the available Virtuozzo Containers release. For example, with the current Virtuozzo Containers version of 4.0, this will be a major update for Virtuozzo Containers 3.0. Minor updates happen within the same Virtuozzo Containers release. Minor updates may be available not only for the latest Virtuozzo Containers release but for previous releases as well. So, in case there is a major update available for your current Virtuozzo Containers installation, you will be presented with a screen like the following:

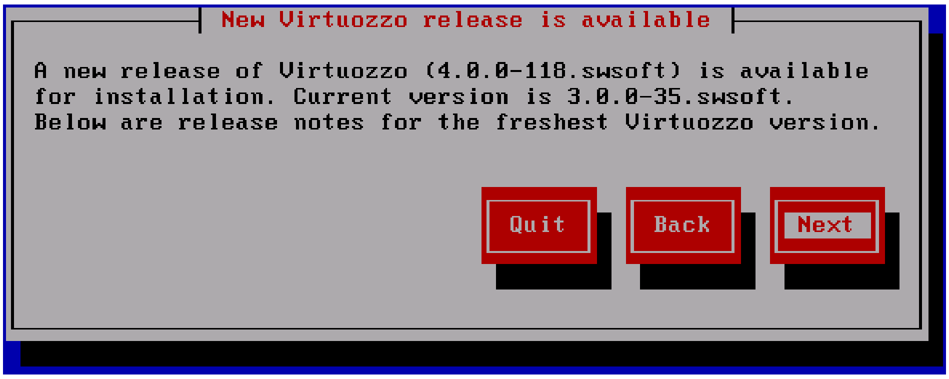

Figure 86: Updating Virtuozzo Containers - Selecting Update Type

Bear in mind that the latest Virtuozzo Containers release you are upgrading to might also already have available minor updates. However, they will not be applied during this invocation of the `vzup2date` utility. So, in order to install the latest Virtuozzo Containers version and then to apply minor updates to it, you will need to launch the utility twice.

Note: The `vzup2date` utility might see that the selected Virtuozzo Containers update includes an updated version of the `vzup2date` utility itself. In this case you will first have to perform an update of this utility and then to re-launch it and select the desired Virtuozzo system update once again.

Depending on the kind of update you choose on this screen, the further steps will differ. Mind also that if there is only a major update or there are only minor updates available, the above screen will be skipped and you will be taken to the corresponding branch of the wizard directly.

Upgrading Parallels Virtuozzo Containers to Latest Release

After you have chosen to upgrade your current Virtuozzo Containers installation to the latest release, you will go through the following steps of the wizard:

- Read the Release Notes for the new Virtuozzo Containers release.
- Confirm the downloading of the new release, the size of which will be indicated.
- After the updated packages have been downloaded, you will be notified if rebooting the server is needed after the upgrading and will need to decide on the system reboot options. If you wish your system to be automatically rebooted upon the updates installation completion, select the **Automatically reboot after update** check box; otherwise, select the **Reboot later manually** check box.

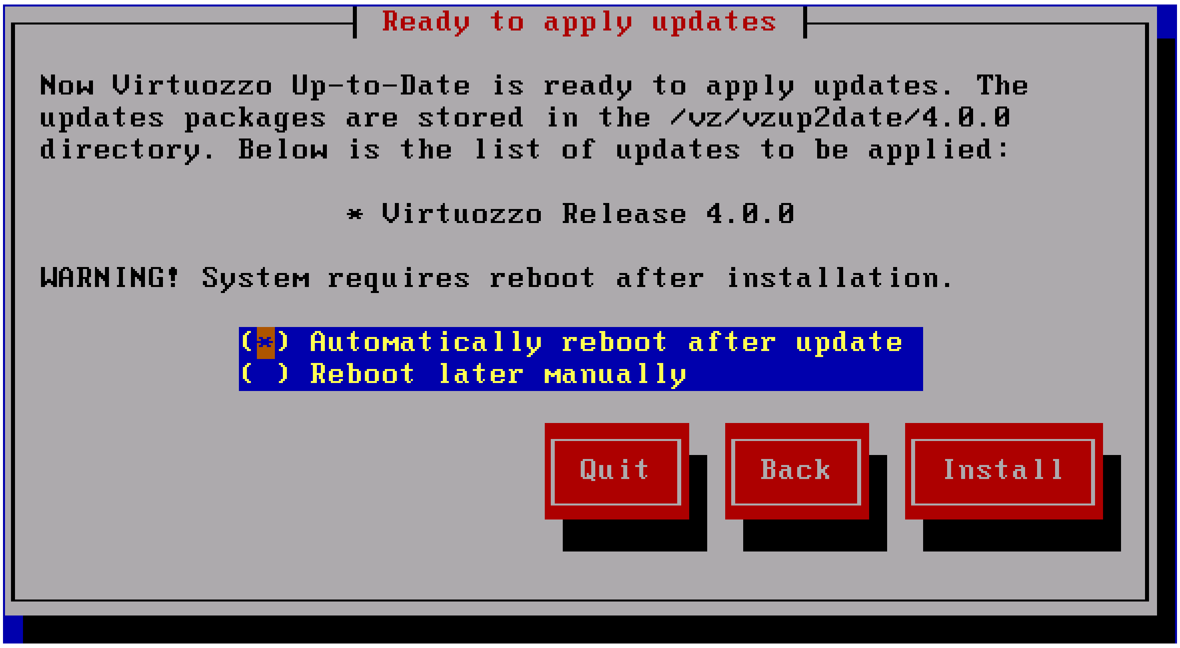

Figure 87: Updating Virtuozzo Containers - Choosing System Reboot Options

- After deciding on the system reboot options, press **Install** to begin installing the latest release. Mind that the Virtuozzo service will be stopped during the upgrading and the Hardware Node rebooting, so all the Containers will not be functional all this time.

Updating Current Virtuozzo Containers Release

Updating the current Virtuozzo Containers release happens when there are no new Virtuozzo Containers releases or if you are not willing to update to the latest release. The utility will first present you with a default list of updates to be applied to your Node. This default list comprises the latest Virtuozzo Containers updates for the given release:

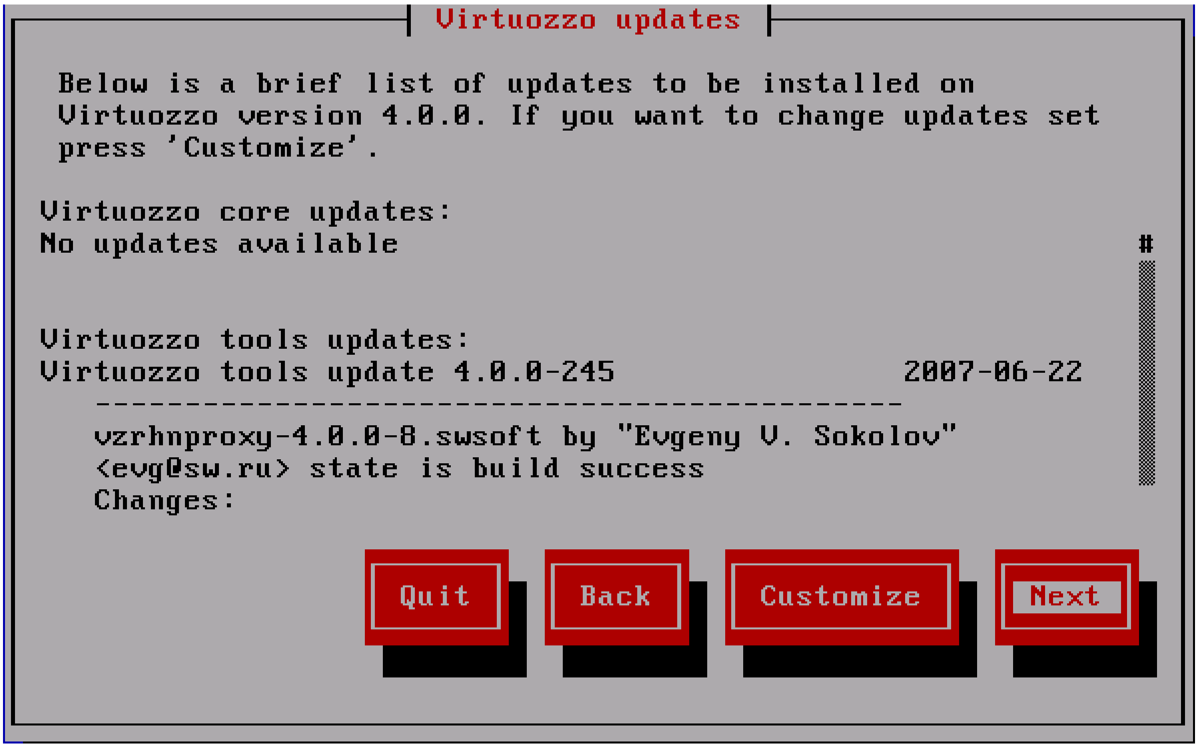

Figure 88: Updating Virtuozzo Containers - List of Selected Updates

If you wish to update to the latest Virtuozzo core and utilities versions, just press Next on this screen and the `vzup2date` utility will download and install them asking your confirmation before each action.

On the other hand, if you have a reason not to install the latest updates for both the Virtuozzo core and Virtuozzo utilities, press Customize. Then you will be able to choose whether to perform customization on the Virtuozzo core or on the Virtuozzo utilities. This step will be skipped if updates are currently available either only for the Virtuozzo core or only for the Virtuozzo utilities. On the next step, you will be asked to choose the needed Virtuozzo core or utilities updates, in case there are many. For example, the available Virtuozzo utilities updates might be presented like this:

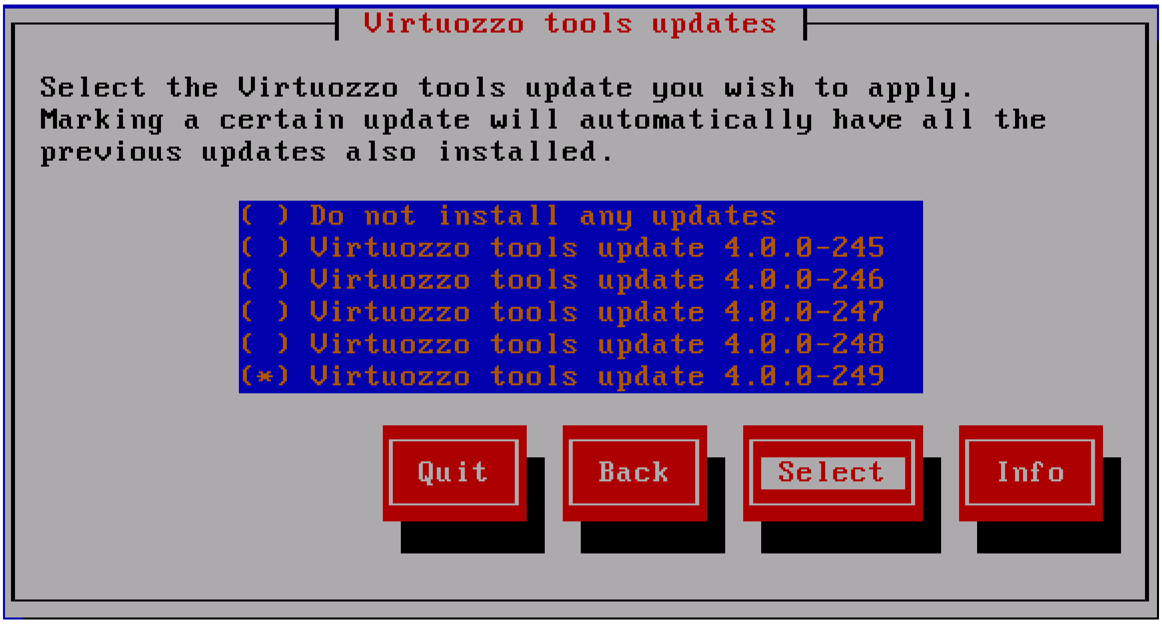

Figure 89: Updating Virtuozzo Containers - Select Virtuozzo Core Updates

The bottommost update includes the functionality of all the other updates. You may select any of the intermediary updates and press **Select** to go back to the **List of Selected Updates** screen and read the information on this update. You will be able to perform customization more than once until you finally decide on the set of updates to be applied and press **Next**.

Downloading and installing the necessary updates is straightforward.

Updating Virtuozzo EZ Templates

Updating Virtuozzo EZ templates consists in updating one or more EZ templates configuration files located in the /vz/template/<os_name>/<os_version>/<arch>/config directory on the Node and takes place if you have launched the `vzup2date` utility with the `-z` option. The first few steps of the wizard were described in the **Updating in Graphical Mode** subsection (p. 250). As soon as you press **Next** in the **Welcome...** window, the utility will try to connect to the EZ templates repository (either the Parallels default repository or your own one) and, if the connection is successful, display the **EZ Templates Selection** window listing all EZ templates that have one or more updates available or that are not installed on your Node at all. For example:

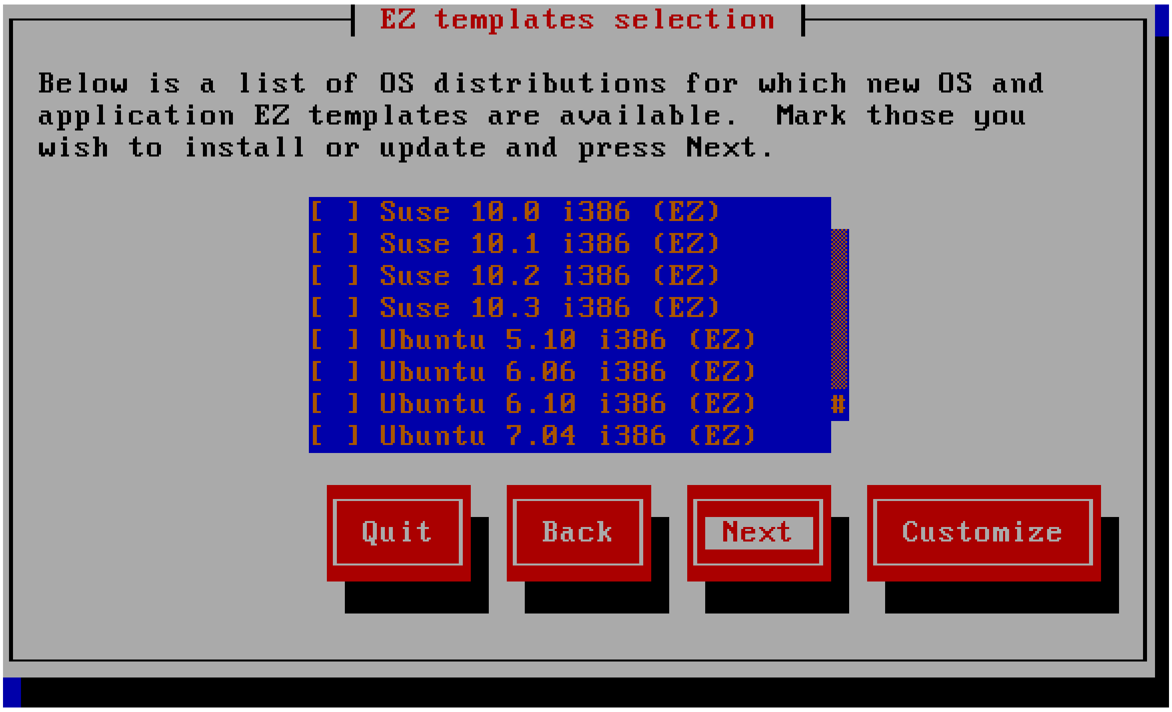

Figure 90: Updating Virtuozzo Containers - Selecting Linux Distribution

In this window you can do one of the following:

- If you wish to download and install all available EZ templates/template updates for a certain Linux distribution, select this distribution by placing the cursor beside it and pressing the space bar on your keyboard; then click **Next**.
- If you wish only certain EZ templates of the corresponding Linux distribution to be installed/updated on the Hardware Node, place the cursor beside this distribution and press F2 on your keyboard. You will be presented with the **Templates selection** window where you can select the corresponding EZ templates:

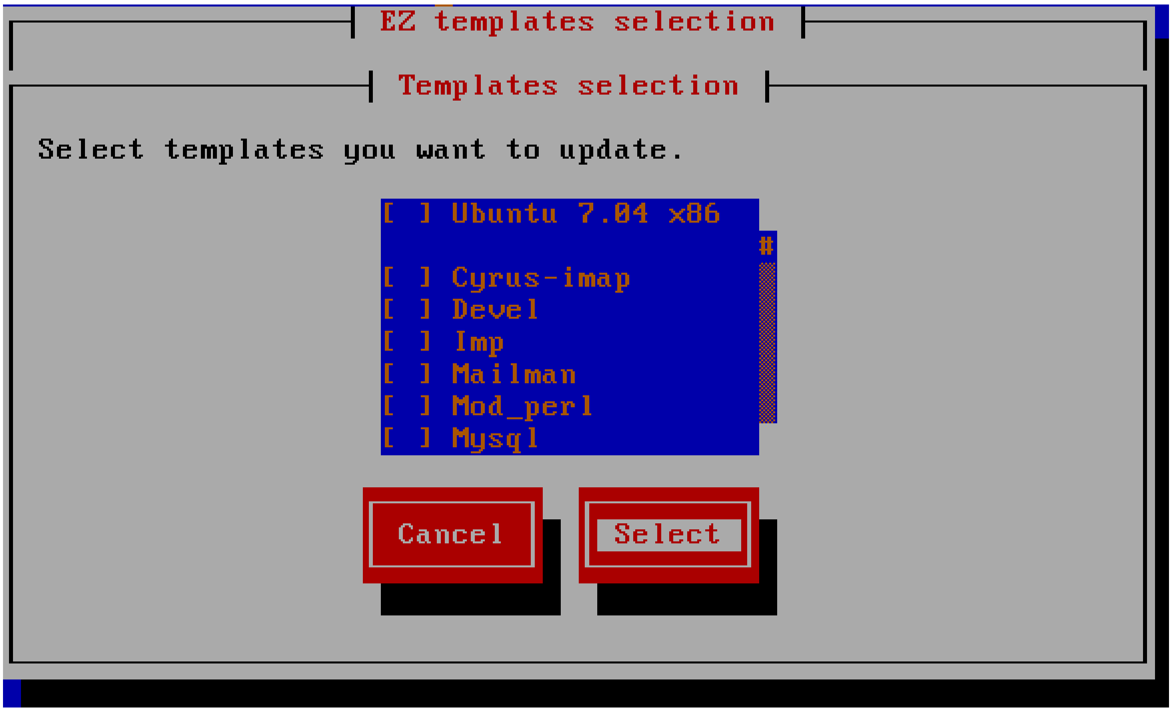

Figure 91: Updating Virtuozzo Containers - Selecting EZ Templates

After choosing the right EZ templates, click the **Select** button to close the displayed window and then click **Next** to proceed with the wizard.

Note: New application EZ templates for a Linux distribution can be installed on the Hardware Node only if the corresponding OS EZ template is already installed on this Node.

On the next step, you can review the EZ templates/template updates you selected on the previous step and scheduled for downloading and installing on your Hardware Node. If you are not satisfied with the chosen templates/template updates, click the **Back** button to return to the previous step and modify the set of templates; otherwise, click **Next** to start downloading the templates/template updates on the Node.

After the EZ templates/templates have been successfully downloaded to the Hardware Node, the **Installing EZ template** window is displayed:

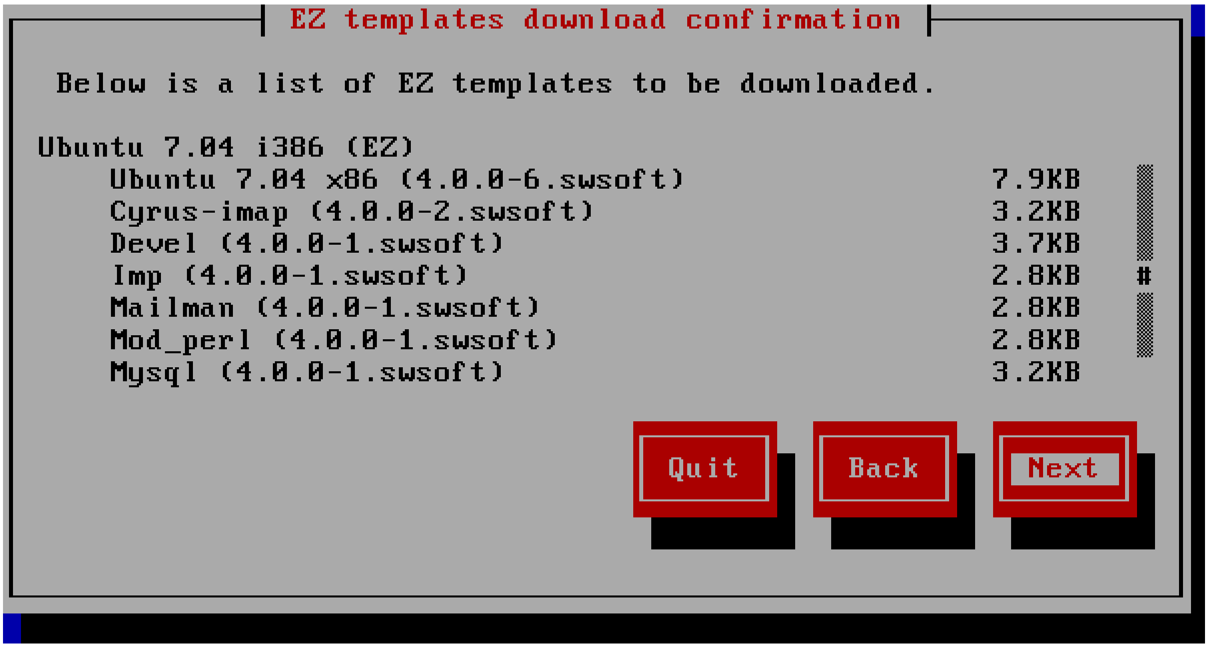

Figure 92: Updating Virtuozzo Containers - Viewing EZ Templates to Install

In this window you can view the templates/template updates ready to be installed on your Node. If you are installing a new OS EZ template/OS EZ template update, you can make use of the **Run vzpkg cache after installation** check box to specify whether to cache the corresponding OS EZ template/template update right after its installation on the Node or to do it at a later time. By default, all OS EZ templates are just installed on the Hardware Node without being cached; however, you can select the provided check box and schedule your OS EZ template/template update for caching. Clicking **Next** starts installing the EZ templates on the Hardware Node. By the time the wizard finishes you should have updated OS and application templates on your system.

Updating Virtuozzo Standard Templates

Updating Virtuozzo standard templates takes place if you have launched the `vzup2date` utility with the `-t` option and, in contrast to EZ templates, includes updating one or more software packages of the corresponding template. The first few steps of the wizard were described in the **Updating Virtuozzo Containers Software** section. After the repository has been checked for the availability of updated templates, the utility will present you with a list of OS templates that you may install and/or update on your server. For example:

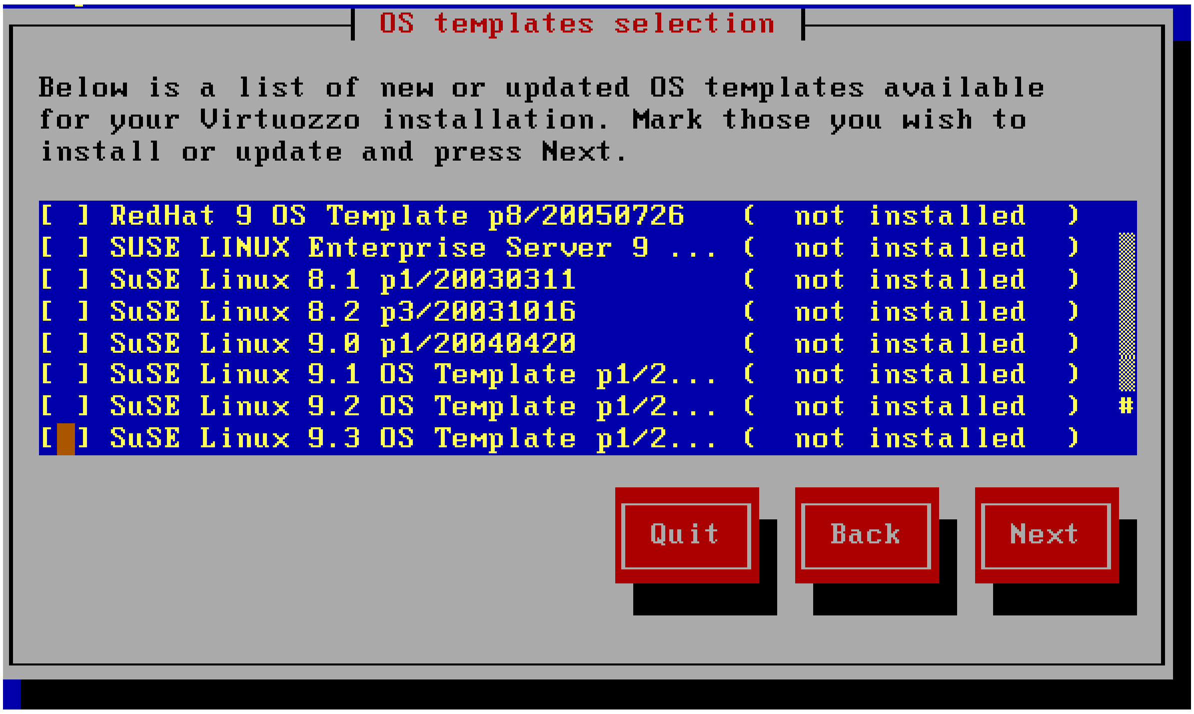

Figure 93: Updating Virtuozzo Containers - Selecting OS Standard Templates

There are two kinds of templates on this list:

1 Templates that are not present on your system. These might be templates that you did not wish to install from the very beginning, so by default they are not selected to be installed this time also. Anyway, you may just as well select them and thus add to your system.

2 Updates to those templates that are already installed with you. By default, these templates are already selected on this screen. It may happen that an update involves the downloading and installing of some intermediary updates, in which case you will see several templates downloaded and installed at the final stages of the wizard. Anyhow, you need to select only the latest update, and all the rest is done automatically.

Review the templates that you wish to install and/or update and click **Next** to go to the application templates selection screens. You will also have the possibility to select not only those application templates that can update your existing applications but install new templates compatible with a set of OS templates installed on your system. Those application templates that are incompatible with the OS templates you chose to install or update on the previous step will not be offered for selection. To schedule this or that application template for being installed/updated, you should click on the **Customize** button and, in the displayed window, select the corresponding templates.

The steps of downloading and installing the selected templates are self-evident. By the time the wizard finishes you should have updated OS and application templates on your system.

Updating in Command Line Mode

Another way of updating your Virtuozzo system files and templates is to run the `vzup2date` utility in the command line mode, which can be done by passing the corresponding commands, switches, and options to `vzup2date`. While executing `vzup2date` in the command line mode, you can choose between the batch and messages submodes. Both submodes can be used to update either the Virtuozzo system files or the Virtuozzo templates and have the identical syntax. However, the output produced by these commands is different. The messages submode output is less user friendly than the batch submode one and is mostly suitable for machine processing.

To run the `vzup2date` utility in the command line mode, you should use either the `-m batch` switch or the `-m messages` switch intended for executing `vzup2date` in the batch and messages submodes, respectively.

Let us assume that you wish to update your Virtuozzo system files by installing the latest Virtuozzo core in the batch submode. To this effect, you can issue the following command on the Hardware Node:

```
# vzup2date -m batch install --core
```

This will check the Virtuozzo repository for the latest Virtuozzo core updates and, in the case of finding any, download and install them on the Hardware Node. However, to be able to update your Virtuozzo Containers installation, you may need to edit the `/etc/sysconfig/vzup2date/vzup2date.conf` file to specify the repository from where the Virtuozzo Containers updates are to be downloaded or configure a number of other parameters. Detailed information on the `vzup2date.conf` file is provided in the Configuring Parallels Virtuozzo Containers chapter of Parallels Virtuozzo Containers Reference Guide.

You can also execute the `vzup2date` utility in the batch mode to update Virtuozzo templates installed on the Hardware Node. For example, you can issue the following command

```
# vzup2date -t -m batch install --all-os
```

to update all OS templates installed on your Node. Detailed information on all options that can be passed to the `vzup2date` utility is given in the Virtuozzo Command Line Interface chapter of the Parallels Virtuozzo Containers Reference Guide.

Note: To perform the aforementioned operations in the messages submode, you should pass the `-m messages` option to the `vzup2date` utility instead of `-m batch`.

Using Parallels Management Console to Update Virtuozzo Containers Software

You can also use Parallels Management Console to keep your Virtuozzo Containers software at the most recent version.

Configuring Virtuozzo Containers Update Server Settings

Before starting the update procedure in Parallels Management Console, you may wish to check and configure, if necessary, the parameters to be used by the Virtuozzo Containers Update wizard while connecting to the update server storing Virtuozzo system and template updates. To view the current settings of the update server, you should right-click the name of the Hardware Node you are going to update in the Parallels Management Console tree pane and select Virtuozzo Containers Update --> Set Up Update Repository on the context menu. You will be presented with the following window:

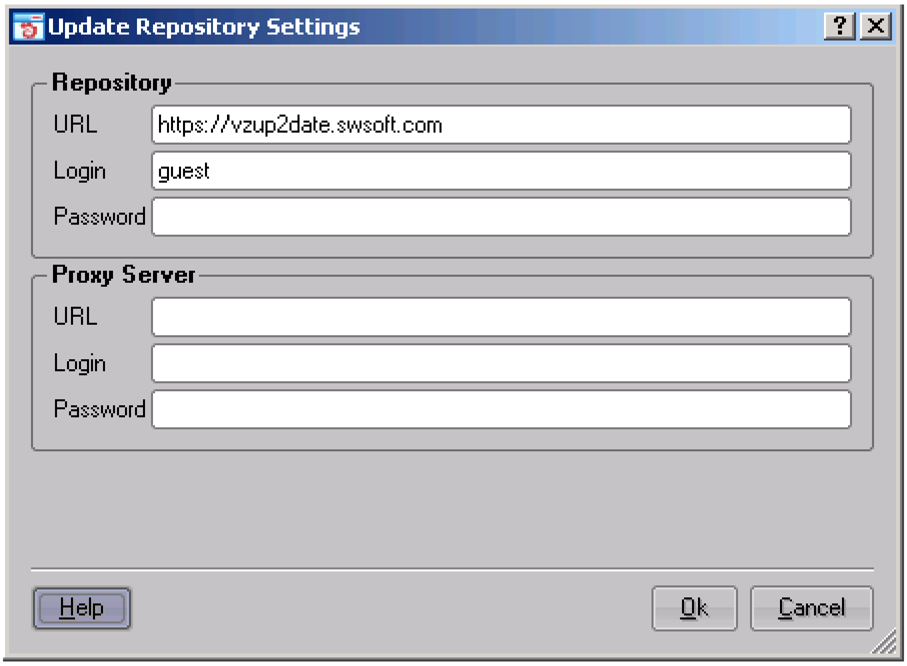

Figure 94: Management Console - Configuring Virtuozzo Update Settings

In this window you can view and modify, if necessary, the following settings:

- Under the Repository group, you can change a number of parameters related to the update server:
  - the URL (Uniform Resource Locator) to be used to connect to the update server (e.g. `http://vzup2date.swsoft.com`)
  - the user name for accessing the update server
  - the password of the user specified in the Login group and used for accessing the update server.
- If you use a proxy server to connect to the Internet, you may also need to specify/configure the following settings for your proxy server:
  - the proxy server address in the URL field (e.g. `http://192.168.1.20`)
  - the user name used by the proxy server for your authentication in the Login field
  - the password of the user specified in the Login field and used for your authentication by the proxy server.

Updating Virtuozzo System Files

Parallels Management Console provides you with a special wizard helping you update your current Virtuozzo Containers software. The Virtuozzo System Update wizard is supposed to check and, if necessary, download and install Virtuozzo system files, i.e newest versions of the Virtuozzo core and utilities. To invoke the wizard, you should right-click the name of the Hardware Node you wish to update and select Virtuozzo Update --> Check for System Updates on the context menu (alternatively, you can follow the Check for System Updates link on the Hardware Node dashboard). The wizard will try to connect to the repository housing updated packages for the Virtuozzo software and, if the connection is successful, you will be presented with a screen containing a list of available updates for your Virtuozzo Containers installation:

Note: If the connection to the update server has failed, the Update Repository Settings window is displayed allowing you to check and configure the settings to be used for connecting to the repository. Detailed information on how to change the parameters in this window is given in the Checking Virtuozzo Update Center Settings subsection.

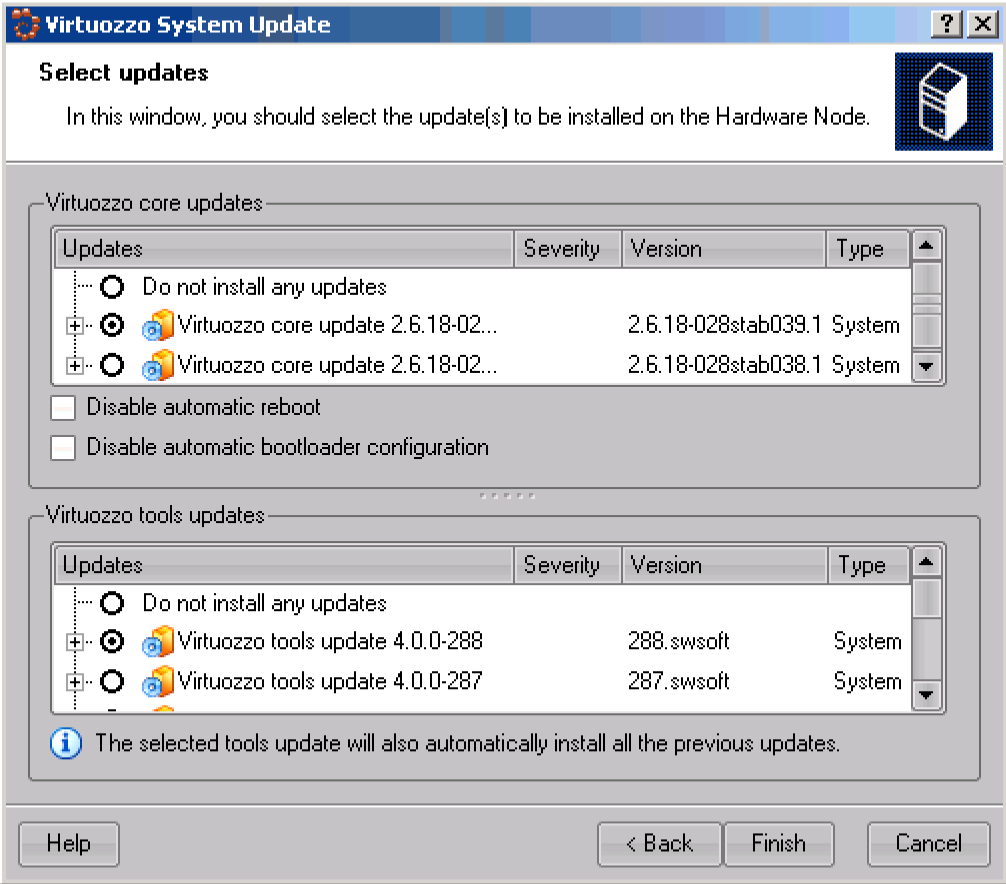

Figure 95: Management Console - Choosing Virtuozzo Updates

All updates that can be currently applied to your system are listed in the Virtuozzo Core Updates (storing the latest patches to the Virtuozzo kernel) and Virtuozzo Tools Updates (storing the latest versions of Virtuozzo command-line utilities) tables on the Select Updates screen. In this window you can do the following:

- If you wish to update to the latest Virtuozzo core and utilities versions, just click Finish on this screen.

- If you wish to install updates of certain Virtuozzo core or utilities only, select the radio buttons next to these updates and click **Finish**. Please keep in mind that the uppermost update includes the functionality of all the other updates (e.g. update `4.0.0-271` includes all the functionality of update `4.0.0-270`).
- If you wish to view detailed information on an update, expand the plus sign next to this update in the corresponding table.
- If you do not wish to install any updates, select the **Do not install any updates** button.

If you are going to install a Virtuozzo core update, you can additionally specify what operations are to be performed after the update installation on the Hardware Node:

- If you wish your system to be automatically rebooted upon the update installation completion, leave the **Disable automatic reboot** check box cleared. Rebooting the Node is usually required for the changes made to the Virtuozzo kernel to take effect.
- If you wish the **Virtuozzo System Update** wizard to automatically reconfigure your system boot loader (either Lilo or Grub) on applying the update, leave the **Disable automatic bootloader configuration** check box cleared; otherwise, select this check box.

When you are ready, click **Finish** to start downloading the selected updates and installing them on the Node.

Updating Templates in Parallels Management Console

Parallels Management Console provides you with the Virtuozzo Templates Update wizard allowing you to update any of EZ and standard templates installed on your Hardware Node. You can also use this wizard to download new templates to the Hardware Node and install them there. To invoke the Virtuozzo Templates Update wizard, right-click the Templates item under the corresponding Hardware Node name and select Check for Template Updates on the context menu. When launched, the wizard tries to connect to the templates repository (either the Parallels default repository or your own one) and, if the connection is successful, display the Select Updates window listing those templates that have one or more updates available or that are not installed on your Node at all. For example:

Note: If the connection to the Virtuozzo Containers update server cannot be established, you will be presented with the Repository Update Settings window where you will be asked to provide the correct information to connect to the update server. Detailed information on how to change the parameters in this window is given in the Checking Virtuozzo Containers Update Server Settings subsection.

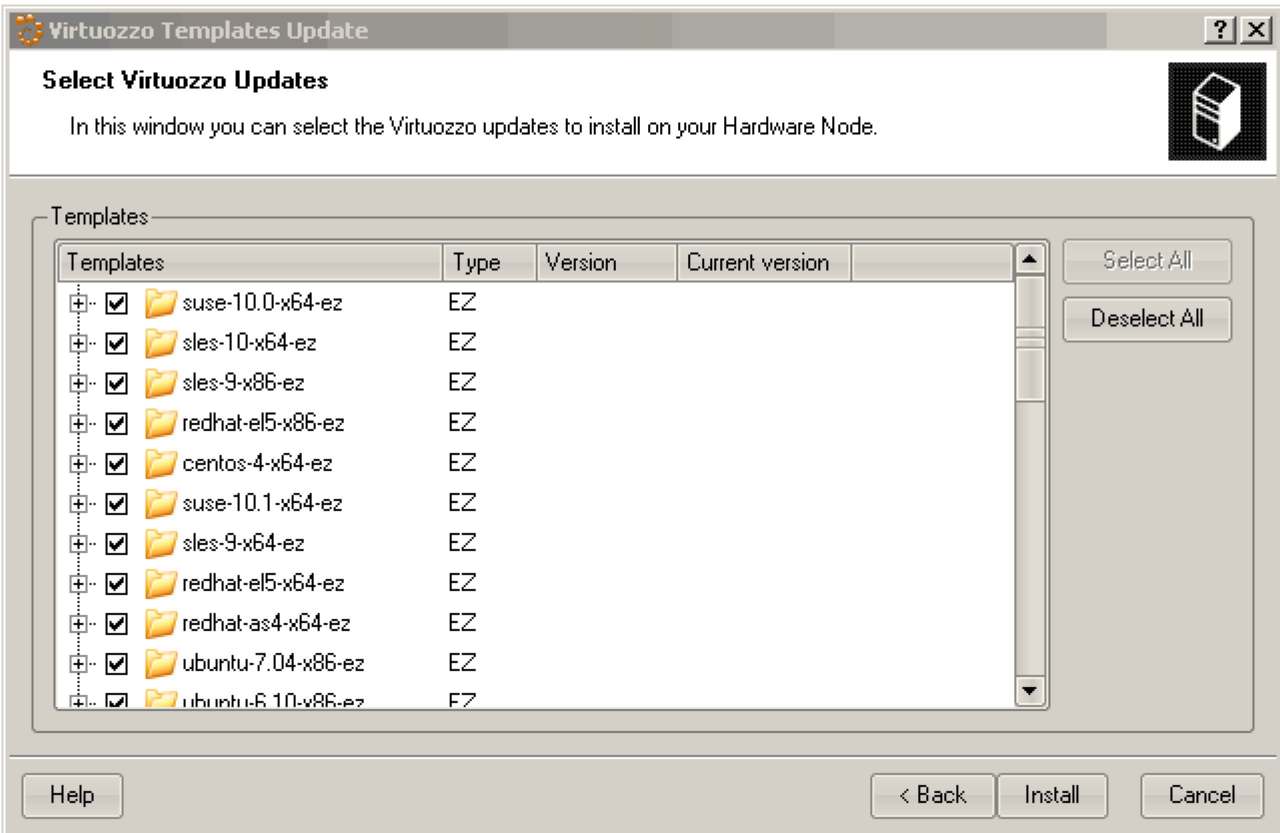

Figure 96: Management Console - Updating EZ Templates

In this window, you can do one of the following:

- If you wish to download and install all available templates/template updates for a certain Linux distribution, click the Next button to go to the next step of the wizard.

- If you wish only certain templates of a Linux distribution to be installed/updated on the Hardware Node, click on the plus sign beside the corresponding Linux distribution to display a list of application templates available for this distribution. You can then get detailed information about a particular template by selecting the corresponding template and viewing its data in the right part of the displayed window. By default, all new templates/template updates are set for downloading to and installing on the Hardware Node. To prevent this or that template from being downloaded/installed, just clear its check box. When you are ready, click **Next**.

Click **Finish** to start installing the selected templates/template updates on the Hardware Node.

Updating Containers

Virtuozzo Containers 4.0 provides you with two facilities allowing to always keep your Containers up-to-date. These facilities include:

- Updating EZ templates software packages inside a particular Container by means of Parallels Management Console or the `vzpkg` utility. Using this facility, you can keep any of the Containers existing on your Hardware Node up-to-date.
- Updating caches of the OS EZ templates installed on the Hardware Node. This facility allows you to create new Containers already having the latest software packages installed.

Updating EZ Template Packages Inside Container

Virtuozzo Containers 4.0 allows you to update packages of the OS EZ template a Container is based on and of any application EZ templates applied to the Container. You can do it by using the `vzpkg update` utility. Assuming that Container 101 is based on the `redhat-el5-x86` OS EZ template, you can issue the following command to update all packages included in this template:

```
# vzpkg update 101 redhat-el5-x86
...
  Updating: httpd                ####################### [1/4]
  Updating: vzdev                ####################### [2/4]
  Cleanup : vzdev                ####################### [3/4]
  Cleanup : httpd                ####################### [4/4]

Updated: httpd.i386 0:2.0.54-10.2 vzdev.noarch 0:1.0-4.swsoft
Complete!
Updated:
 httpd                  i386      0:2.0.54-10.2
 vzdev                  noarch    0:1.0-4.swsoft
```

Notes: 1. A Container has to be running in order to update EZ templates inside this Container.

2. If you are going to update the cache of a commercial OS EZ template (e.g. Red Hat Enterprise Server 5 or SLES 10), you should first update software packages in the remote repository used to handle this OS EZ template and then proceed with updating the EZ template cache. Detailed information on how to manage repositories for commercial Linux distributions is provided in the Setting Up Repositories and Proxy Servers for EZ Templates section of the Parallels Virtuozzo Containers Templates Management Guide.

As you can see from the example above, the `httpd` and `vzdev` applications have been updated for the `redhat-el5-x86` OS EZ template. If you wish to update all EZ templates (including the OS EZ template) inside Container 101 at once, you should execute the following command:

```
# vzpkg update 101
...
Running Transaction
  Updating  : hwdata               ###################### [1/2]
  Cleanup   : hwdata               ###################### [2/2]

Updated: hwdata.noarch 0:1.0-3.swsoft
Complete!
Updated:
 hwdata                 noarch    0:0.158.1-1
```

In the example above, only the `hwdata` package inside Container 101 was out of date and updated to the latest version.

This window displays all packages which are included in the EZ templates applied to your Container.

Select the check boxes of the packages you wish to update and click on the **Update** button. You can use the **Select All** and **Deselect All** buttons to select/deselect all packages included in your EZ templates. On this screen, you can also select the **Force template(s) installation** check box to force the EZ template installation inside the Container. In this case no dependencies and no available versions of the application EZ template will be checked during its installation, which may cause the application EZ template to malfunction.

In Parallels Management Console, you should perform the following operations to update the OS EZ template a Container is based on and/or any of its application EZ templates:

1 Open a list of Containers in the Management Console main window by selecting the **Virtuozzo Containers** item in the Hardware Node tree.
2 Double-click the name of the Container where you wish to add an EZ template to open the Container Manager.
3 Click the **Templates** item in the main tree of the opened Container Manager.
4 In the Management Console right pane, click either the **OS Templates** or **Application Templates** tab depending on what EZ template you wish to update.
5 Right-click the corresponding EZ template and select the **Update Installed Packages** option on the context menu. For example:

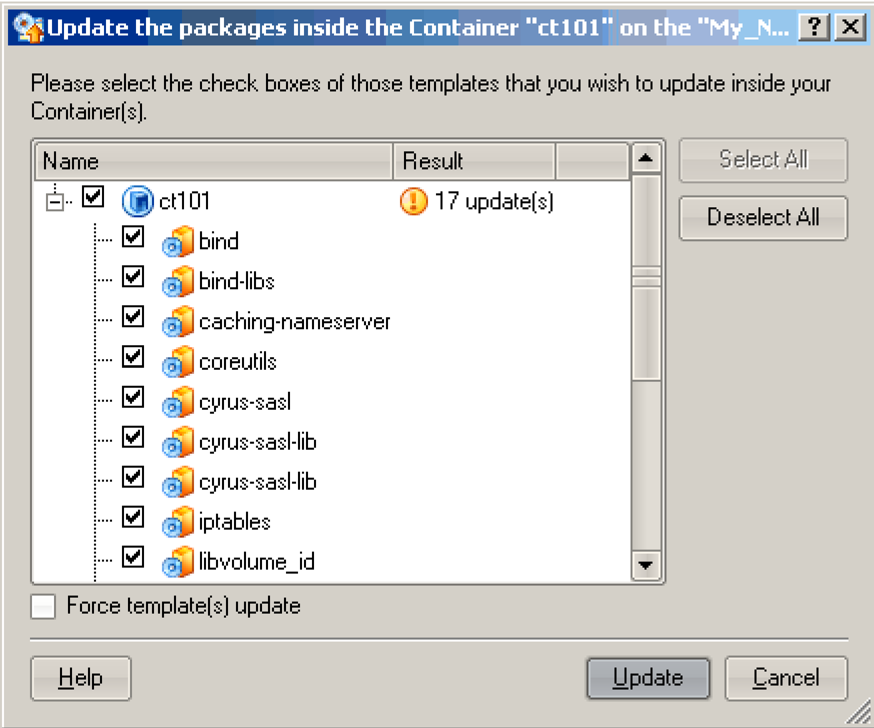

Figure 97: Management Console - Updating EZ Template Packages Inside Container

This window displays all the packages that are included in the EZ templates (both OS and application) applied to your Container.

6 Select the check boxes of the packages you wish to update and click on the **Update** button. You can use the **Select All** and **Deselect All** buttons to select/deselect all packages included in your EZ templates. On this screen, you can also select the **Force template(s) installation** check box to force the EZ template installation inside the Container. In this case no dependencies and no available versions of the application EZ template will be checked during its installation, which may cause the application EZ template to malfunction.

Updating OS EZ Template Caches

With the release of new updates for the corresponding Linux distribution, the created OS EZ template cache can become obsolete. So, Virtuozzo Containers 4.0 provides the `vzpkg update cache` command allowing you to quickly update any of the OS EZ template caches available on the Hardware Node.

Note: If you are going to update the cache of a commercial OS EZ template (e.g. Red Hat Enterprise Server 5 or SLES 10), you should first update software packages in the remote repository used to handle this OS EZ template and then proceed with updating the EZ template cache. Detailed information on how to manage repositories for commercial Linux distributions is provided in the Setting Up Repositories and Proxy Servers for EZ Templates section.

When executed, `vzpkg update cache` checks the `cache` directory in the template area (by default, the template area is located in `/vz/template`) on the Hardware Node and updates all existing tarballs in this directory. However, you can explicitly indicate the tarball for what OS EZ template should be updated by specifying the OS EZ template name. For example, to update the tarball for the `fedora-core-8-x86` OS EZ template, you should issue the following command:

```
# vzpkg update cache fedora-core-8-x86
Loading "rpm2vzrpm" plugin
Setting up Update Process
Setting up repositories
base0            100% |=========================|  951 B    00:00
base1            100% |=========================|  951 B    00:00
base2            100% |=========================|  951 B    00:00
base3            100% |=========================|  951 B    00:00
...
```

Upon the `vzpkg update cache` execution, the old tarball is renamed by receiving the `-old` suffix (e.g. `fedora-core-8-x86.tar.gz-old`):

```
# ls /vz/template/cache
fedora-core-8-x86.tar.gz  fedora-core-8-x86.tar.gz-old
```

You can also pass the `-f` option to `vzpkg update cache` to remove an existing tar archive and create a new one instead of it.

If the `vzpkg update cache` command does not find a tarball for one or several OS EZ templates installed on the Node, it creates tar archives of the corresponding OS EZ templates and puts them to the `/vz/template/cache` directory.

To update an OS EZ template cache in Parallels Management Console, you should:

1 Select the **Templates** item under the corresponding Hardware Node name in the Management Console left tree.

2 In the Management Console right pane, click the **OS Templates** tab to display a list of OS templates installed on the Node.

3 Right-click the template you wish to cache in the right pane and select **Cache OS Template** on the context menu. For example:

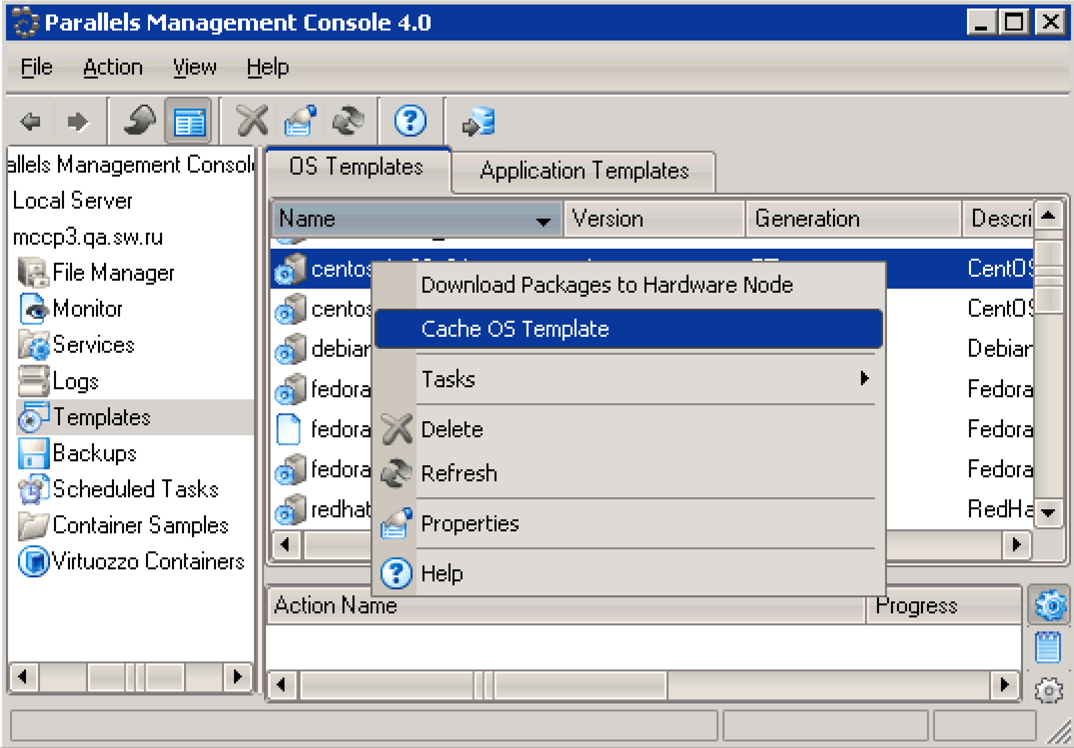

Figure 98: Management Console - Caching OS Template

CHAPTER 10

Compatibility With Previous Versions of Virtuozzo Containers

Parallels Virtuozzo Containers has done its best to provide backward and upward compatibility between the functionality available in Virtuozzo Containers 4.0 and that of earlier versions of Parallels Virtuozzo Containers (e.g. in Virtuozzo Containers 3.0 or 2.6.2). However, a great number of new features and improvements, which have required significant changes in the Virtuozzo kernel and its other structural components, do present some challenges for interoperability between Virtuozzo Containers 4.0 and its predecessors. The main compatibility issues are summarized in the following table:

Issue	Description	Solution
New backup utilities	New `vzabackup` and `vzarestore` utilities are used by Virtuozzo Containers 4.0 to manage Container backups.	Using the `vzbackup` and `vzrestore` utilities to manage Container backups on Hardware Nodes running previous versions of Virtuozzo Containers.
VZFS v2	Virtuozzo Containers 4.0 comes with a new version of Virtuozzo File System - Version 2 (VZFS v2) having no backward compatibility with the previous version of VZFS - VZFS v1. For example, this may result in the impossibility of starting a Container migrated from a 4.0 Virtuozzo Hardware Node on a Virtuozzo 3.0 Node.	Configuring the Virtuozzo global configuration file on a 4.0 Hardware Node to prevent the automatic applying of the VZFS v2 technology to all newly-created Containers on this Node.
VZFS v1 on upgraded Nodes	Virtuozzo 3.0 Hardware Nodes upgraded to version 4.0 continue using VZFS v1 for all legacy and newly created Containers.	Upgrading legacy Containers and configuring the system to make new Containers automatically use VZFS v2.
New layout of the Container directory structure	Virtuozzo Containers 4.0 comes with a newly designed Container directory structure imposing a number of restrictions on managing Containers with different directory structures, e.g. the impossibility of: ▪ restoring a Container with the new directory structure on a Node running Parallels Virtuozzo Containers 3.0; ▪ migrating a Container with the new directory structure to a Node running Parallels Virtuozzo Containers 3.0.	The full support of the old Container directory structure on Virtuozzo 4.0 Hardware Nodes. The restriction of performing unsupported operations on Containers with the new directory structure.
Old Container directory layout for legacy Containers on upgraded Nodes	All legacy Containers on the Hardware Nodes upgraded to Virtuozzo Containers 4.0 continue using the old Container directory layout.	Converting legacy Containers to the new Virtuozzo Containers 4.0 directory layout.

New license scheme	A new Virtuozzo licensing scheme has been implemented in Virtuozzo Containers 4.0, which makes it impossible to continue using old licenses on Hardware Nodes after upgrading them to Virtuozzo Containers 4.0.	The automatical upgrade of the Virtuozzo license during the Hardware Node upgrade to Virtuozzo Containers 4.0.
New configuration sample files	New configuration sample files are shipped with Virtuozzo Containers 4.0 and used for creating Containers.	The possibility of using old configuration sample files for creating Containers on Virtuozzo 4.0 Hardware Nodes.
New security scheme implementation	All permissions of the roles created on 3.0 Hardware Nodes using Parallels Infrastructure Manager are lost after upgrading to Virtuozzo Containers 4.0.	Assigning the lost permissions to the roles anew.
New command options for `vznetcfg`	New `vznetcfg` command options are used in Virtuozzo Containers 4.0 for managing the Virtuozzo network.	The possibility of using old `vznetcfg` commands for managing Virtuozzo network components.
Container requests made by Parallels Infrastructure Manager users not kept	If you have not processed any requests for new Containers submitted by Infrastructure Manager users, these requests will not be retained after the upgrade to Virtuozzo Containers 4.0.	Processing all the Container requests before the upgrade.
The self-registration of new users in Parallels Infrastructure Manager not supported	The "Infrastructure Manager Users Self-Registration" feature present in previous versions of Virtuozzo Containers and used by new users to self-register in Infrastructure Manager and request Containers is not supported any more in Virtuozzo Containers 4.0.	Registering external databases in Infrastructure Manager and allowing any users from the registered databases to request Containers by assigning the "Workflow User" role to these users.
`vzuncache` and `vzlscache` dropped	The `vzuncache` and `vzlscache` utilities are not supported any more in Virtuozzo Containers 4.0 and can be used for managing Container caches on Virtuozzo 3.0 Hardware Nodes only.	The new `vzcache` utility does not any more require Containers to be detached from their caches before performing Container-related operations (e.g. migrating a Container from one Hardware Node to another).

Detailed information on all these features is provided in the following sections.

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Running vzbackup/vzrestore Utilities

If you have one or more Hardware Nodes running a Virtuozzo Containers version other than 4.0 (e.g. Virtuozzo Containers 3.0), you can use:

- the `vzbackup` utility to create backups of Containers residing on these Nodes;
- the `vzrestore` utility to manage the existing Container backups on the Backup Node (e.g. view detailed information on backups or restore Containers from their backups).

The `vzbackup` utility is run on the Backup Node connecting via SSH to the Hardware Node(s) where some or all Containers are to be backed up and puts the tarballs (either compressed or not) into the directory defined in the `/etc/vzbackup.conf` global backup configuration file (by default, this directory is `/vz/backups`). Later on, the Container backups may be restored from this directory. Assuming that you are going to back up all the Containers on the Node running Virtuozzo Containers 3.0 and having the IP address of `192.168.1.165`, you may run the following session on the Backup Node (i.e. on any Hardware Node running Virtuozzo Containers 4.0):

```
# vzbackup -i -Cg -s 192.168.1.165
root@192.168.1.165's password:
vzbackup(16013): Starting backup. Nodes - dhcp-165.asplinux.ru
vzbackup(16013): Starting node dhcp-165.asplinux.ru backup...
vzbackup(16013): Node dhcp-165.asplinux.ru archived \
Containers: 101(2006-06-27T115742+0400@dhcp-165.asplinux.ru) \
1(2006-06-27T115749+0400@dhcp-165.asplinux.ru)
vzbackup(16013): Cleaning up
```

The `–s` option in the session above forces the Containers to be stopped for the time necessary for their backing up. In this case, if a client tries to access the Containers during their downtime, a temporary "busy" page is shown. You may use the `–n` option to back up the Containers while they are running, which is better, on the one hand, but does not guarantee the Containers consistency, on the other. If neither `–n` nor `–s` is specified, the backup configuration file is consulted for the default value (the `BACKUP_CTSTOP` parameter).

The `-Cg` switch compresses the resulting Container backups with the `gzip` archiver. You can also use the `bzip2` algorithm or do without any compression. Whether to use compression or not and the compression method itself are defined in the global backup configuration file and can be overridden by the command line switches. For the full list of configuration file parameters and command line options, turn to the Parallels Virtuozzo Containers Reference Guide.

Note: You may as well compress the Container tarballs manually later. Provided the archives will be situated in the same directory and will have an identical name (before the extension), this will not hinder the Containers from being restored when time comes. A Container may be restored from files with any of the following extensions: `.tar`, `.tar.gz`, `.tgz`, `tar.bz2`.

The type of the backup to be performed is specified by one of the following 3 options:

- `-F` a plain full backup;
- `-I` a full backup;

- `-i` an incremental backup containing only the files changed since the previous “I” or “i” backup.

If you specify the `–i` option, and the utility cannot find the corresponding full backup, a full backup is performed.

You may specify any number of Hardware Nodes names or IP addresses in the command line. You may also enter these names as the value of the `BACKUP_NODES` parameter in the global backup configuration file to avoid the necessity to specify them in the command line. In this case, you shall specify the `–a` option instead.

If you wish to back up not all, but select Containers from the specified Node, use the `–e` or `–x` switches (include or exclude the specified Containers, respectively). For example:

```
# vzbackup -i -s 192.168.1.165 -e 101
root@192.168.1.165's password:
vzbackup(17344): Starting backup. Nodes - dhcp-165.asplinux.ru.
vzbackup(17344): Starting node dhcp-165.asplinux.ru backup...
vzbackup(17344): Node dhcp-165.asplinux.ru archived Containers: \
101(2006-06-27T120326+0400@dhcp-165.asplinux.ru)
vzbackup(17344): Cleaning up...
```

In this session, only Container 101 will be included in the backup.

Note: A number of default parameters in the global backup configuration file may be adjusted for a particular Hardware Node to be backed up. To this effect, you should create a new configuration file named `<node>.conf` and put it to the backup directory (defined by the `BACKUP_DIR` parameter in the global backup configuration file). This file should contain those parameters that you want to re-write for a particular Node. Still, a number of other parameters may further be adjusted for a particular Container to be backed up. In this case these parameters should be inserted into the corresponding Container configuration file (`/etc/vz/conf/CT_ID.conf`). For a complete list of those backup parameters that are allowed to be used in per-Node and per-Container configuration files, see the **Backup Configuration File** section in the **Parallels Virtuozzo Containers Reference Guide**.

To restore any Hardware Nodes previously backed up or separate Containers, you might want to view first the information about these Containers:

```
# vzrestore -l
Container 101 dir /vz/backups/dhcp-165.asplinux.ru
2006-06-27T122705+0400@dhcp-165.asplinux.ru type I
```

To do the restoring proper, issue the following command:

```
# vzrestore dhcp-165.asplinux.ru -e 101
vzrestore(23558): Starting restore Container \
101(2006-06-27T122705+0400@dhcp-165.asplinux.ru) \
on node dhcp-165.asplinux.ru...
vzrestore1 (101): Container is mounted. Exiting...
vzrestore(23558): Failed to restore dhcp-165.asplinux.ru Container 101 tag .
vzrestore(23558): Done.
# vzctl stop 101
Removing stale lock file /vz/lock/101.lck
Stopping Container ...
Container was stopped
Container is unmounted
# vzrestore dhcp-165.asplinux.ru -e 101
vzrestore(23960): Starting restore Container \
101(2006-06-27T122705+0400@dhcp-165.asplinux.ru) \
on node dhcp-165.asplinux.ru...
vzrestore1 (101): Created /vz/backup/101/tmpfyPsqw
```

```
vzrestore1 (101): Restoring Container...
vzrestore1 (101): \
/vz/backups/dhcp-165.asplinux.ru/101/101-2006-06-27T122705+ \
0400@dhcp-165.asplinux.ru-I.tar...
vzrestore1 (101): Replacing /etc/vz/conf/101.conf...
vzrestore1 (101): Moving /vz/private/101 to \
vz/backup/101/tmpfyPsqw/101.tmp...
Saved parameters for Container 101
vzrestore1 (101): Cleaning up...
vzrestore1 (101): Done.
vzrestore(23960): Done.
```

Use the `–e` or `–x` switches in the same way as for the `vzbackup` utility. You may also use the `–d` option to specify the Destination Node where the Containers are to be restored instead of the default behaviour of restoring the Containers to their Source Node.

Note: The `vzrestore` utility does not restore Containers by the Hardware Nodes IP addresses, but only by their hostnames, even if the backing up was performed by means of IP addresses.

Configuring Upgraded Nodes to Use VZFS v2

Parallels Virtuozzo Containers 3.0 Hardware Nodes upgraded to version 4.0 continue using VZFS v1, i.e. all legacy Containers on these Nodes continue operating on VZFS v1 and all new Containers are also created on the basis of this VZFS version. If you wish to use VZFS v2, which is the default VZFS version on Hardware Nodes with fresh installations of Parallels Virtuozzo Containers 4.0, on the upgraded Nodes, you can proceed as follows:

- Upgrade all legacy Containers to use VZFS v2. To this effect:
  - Run the following command for each OS template installed on the Node:

```
# vzpkg upgrade area OS_Template_Name
```

  - Issue the following command for each legacy Container residing on the Node:

```
# vzfsutil --upgrade --ctid=CT_ID -t /vz/template /vz/private/CT_ID
```

- Make all newly created Containers automatically use VZFS v2. To this effect:
  - Ascertain that the value of the `VEFORMAT` parameter in the Virtuozzo global configuration file (`/etc/vz/vz.conf`) is set to `vz4`:

```
# grep VEFORMAT /etc/vz/vz.conf
VEFORMAT="vz4"
```

  - Recreate the caches of all OS templates installed on the Node by running the following commands:

```
# vzpkg remove cache OS_Template_Name
# vzpkg create cache OS_Template_Name
```

New Directory Structure Restrictions

The Container directory structure layout (`/vz/private/CT_ID`) has been modified in Virtuozzo Containers 4.0 to make the Container file structure more understandable and user-friendly. However, the implementation of the new directory structure imposes a number of restrictions on managing Containers created on Virtuozzo 4.0 Hardware Nodes. These are the following restrictions:

- You cannot restore a Container supporting the new directory structure on a Hardware Node running a Virtuozzo Containers version older than 4.0.
- You cannot migrate a Container supporting the new directory structure to a Hardware Node running a Virtuozzo Containers version older than 4.0.
- Once a Container is converted to support the new directory structure, you cannot convert it back to the old directory layout.

Upgrading Legacy Containers to Support New Directory Layout

All legacy Containers on the Hardware Nodes upgraded from Virtuozzo Containers 3.0 or 3.0 SP1 to 4.0 continue using the old Container directory layout. The old and new layouts have the following differencies:

- In the old layout, the Container-related files are dispersed over the whole Hardware Node file system.
- In the Virtuozzo Containers 4.0 layout, the Container-related files are stored in the `/vz/private/CTID` directory.

You can convert any Container using the old layout to support the new Virtuozzo Containers 4.0 layout. This conversion is performed via the `vzctl convert` command. The following example demonstrates how you can convert Container 101 to support the new directory layout:

```
# vzctl convert 101
Container registered succesfully
Container converted succesfully
```

Note: Keep in mind that the `vzctl convert` command requires the Container to be stopped.

After Container 101 has been converted, keep in mind that:

- it is not possible to convert it back into the Virtuozzo 3.0 or 3.0 SP1 layout
- it is not possible to migrate it to the Hardware Node running Virtuozzo Containers 3.0 or 3.0 SP1
- it is not possible to restore its backup on the Hardware Node running Virtuozzo Containers 3.0 or 3.0 SP1.

If you are not sure which layout the Container is using, log in to the Hardware Node hosting this Container and list the files and subdirectories in the `/vz/private/CTID` directory:

- In the new Container layout, the Container file system is stored in the `/vz/private/`*`CT_ID`*`/fs` directory. The presence of this directory indicates that the given Container supports the new layout. For example:

```
# ls /vz/private/101
dump  fs  quota.fs  scripts  templates  ve.conf
```

- The absence of the `/fs` directory denotes that the Container uses the old directory layout. For example:

```
# ls /vz/private/101
cow  root  templates  VERSION
```

You should pay special attention to the cases when you have to migrate a legacy Container to the Hardware Node where the `/vz` directory is created on a shared partition (e.g. in the Virtuozzo failover cluster). This kind of migration is directly relevant to the layout conversion.

The way of migrating a legacy Container to a cluster server running Virtuozzo Containers 4.0 is described in detail in the following subsection.

Migrating Legacy Container to Cluster Server

In a Virtuozzo cluster, the `/vz` directory is created on a shared partition and Containers using the old layout cannot be migrated to this directory in the usual way. The current subsection explains how you can migrate a legacy Container to a Hardware Node which is used as a cluster server. Let us assume that we have to migrate Container 101 using the old layout to the cluster server. The cluster server IP address is 10.28.252.69. To perform the migration, follow these guidelines:

1 Log in to the Hardware Node hosting Container 101 and migrate the Container to the cluster server private area. In our example, we migrate Container 101 to `/tmp/private/101`:

```
# vzmigrate root@10.28.252.69 101:101:/tmp/private/101
root@10.28.252.69's password:
Connection to destination node (root@10.28.252.69) is successfully established
Moving/copying CT#101 -> CT#101, [/tmp/private/101], [] ...
Checking external bind mounts
Check cluster ID
Checking keep dir for private area copy
Checking SLM-only mode
Checking technologies
Checking disk usage space
Checking templates for CT
copy ez template area directories
Checking caches
Checking IP addresses on destination node
Checking RATE parameters in config
Copy private area '/vz/private/101'
done
OfflineManagement CT#101 ...
done
Successfully completed
```

2 Log in to the cluster server and convert Container 101 to support the new Virtuozzo Containers 4.0 layout:

```
# vzctl convert 101
file lock /vz/lock/101.lck
Running command: cp -f /etc/vz/conf/101.conf /tmp/private/101/ve.conf
Running command: cp -f /var/vzquota/quota.101 /tmp/private/101/quota.fs
Moving /tmp/private/101/root -> /tmp/private/101/fs/root
Moving /tmp/private/101/cow -> /tmp/private/101/fs/cow
Moving /tmp/private/101/.vzpkgset -> /tmp/private/101/fs/.vzpkgset
Moving /tmp/private/101/.vzpkgver -> /tmp/private/101/fs/.vzpkgver
Moving /tmp/private/101/VERSION -> /tmp/private/101/fs/VERSION
Container registered succesfully
flock lock /var/tmp/cluster_service.lck
Container converted succesfully
```

3 Migrate Container 101 to the /vz directory residing on the shared partition. On the cluster server, execute the following command:

```
# vzmlocal 101:101:/vz/private/101
Moving/copying CT#101 -> CT#101, [/vz/private/101], [] ...
Check disk space
Syncing private area '/tmp/private/101'->'/vz/private/101'
done
Copying/modifying config scripts of CT#101 ...
OfflineManagement CT#101 ...
done
OfflineManagement CT#101 ...
done
Successfully completed
```

As you can see, Container 101 has been successfully migrated to the cluster server. You can use this method to migrate a legacy Container not only to a cluster server but also to any Hardware Node with the `/vz` directory installed on a shared partition.

Using New License Scheme on Virtuozzo 3.0 Nodes

The new licensing scheme implemented in Virtuozzo Containers 4.0 deals with one license only - a Virtuozzo Server license. This license is needed to start using the Parallels Virtuozzo Containers software and all Virtuozzo management tools (Parallels Management Console, Parallels Infrastructure Manager, and Parallels Power Panel).

Parallels Virtuozzo Containers 4.0 allows for an easy upgrade of all licenses installed on your Hardware Node. It means that all valid licenses on the Node (e.g. the Parallels Infrastructure Manager and Virtuozzo licenses) are automatically upgraded to support Virtuozzo Containers 4.0 when upgrading the corresponding Hardware Node to version 4.0. However, please keep in mind that this process is not backward-compatible, i.e. once your license is upgraded, you will not be able to auto-return to the old licensing format.

New Command Options for vznetcfg

The following changes have been made to the `vznetcfg` utility in Virtuozzo Containers 4.0:

- The following `vznetcfg` command options have been replaced with new ones:

Old Option	New Option
`br new`	`net new`
`br del`	`net del`
`br change`	`net change`
`br attach`	`net addif`
`br detach`	`net delif`
`br list`	`net list`

  Virtuozzo Containers 4.0 supports both old and new `vznetcfg` command options. However, you are highly recommended to make use of new options when managing the Virtuozzo network since the support of old options will be dropped in the future versions of Virtuozzo Containers.

- The support of the following options for `vznetcfg` has been dropped:
  - `br show`;
  - `addr set`;
  - `addr show`;
  - `route add default via`;
  - `route del default`;

  - `route show`;
  - `route list`.
- The `vznetcfg` utility does not deal with bridge IDs any more; the emphasis is put on Virtual Networks instead.

For detailed information on `vznetcfg` and all its options, please turn to the Managing Virtuozzo Network chapter (p. 205) and the Parallels Virtuozzo Containers Reference Guide.

Using Old Configuration Files for Container Creation

The configuration sample files shipped with Virtuozzo Containers 3.0 have undergone the following changes in Virtuozzo Containers 4.0:

- All the configurations samples have been renamed as follows:

Virtuozzo Containers 3.0	Virtuozzo Containers 4.0
vps.basic	basic
vps.confixx	confixx
vps.cpanel	cpanel
db.oracle	oracle
vps.plesk7.rh9	slm.plesk
vps.256MB	slm.256MB
vps.512MB	slm.512MB
vps.1024MB	slm.1024MB
vps.2048MB	slm.2048MB

- The `vps.basic` default configuration sample set in the Virtuozzo global configuration file and used in Virtuozzo Containers 3.0 for creating Containers is replaced with the `basic` configuration sample.
- The `unlimited.db2` configuration sample has been dropped from the Virtuozzo Containers 4.0 distribution set.
- The resources values of the following configuration samples have been changed in Virtuozzo Containers 4.0:
  - `ve-vps.1024MB.conf-sample`;
  - `ve-vps.2048MB.conf-sample`;
  - `ve-vps.256MB.conf-sample`;
  - `ve-vps.512MB.conf-sample`;
  - `ve-vps.plesk7.rh9.conf-sample`.

As a result, these configuration sample files are moved to the /etc/vz/conf/old_configs directory on the Hardware Node when upgrading to Virtuozzo Containers 4.0. So, you cannot use them in Virtuozzo Containers 4.0 as the basis for the Container creation. If you, however, wish to continue using any of these templates, you can proceed as follows:

a Create a new configuration sample file (e.g. in Parallels Management Console) and base it on the corresponding old configuration sample.

b Copy the needed configuration sample from the /etc/vz/conf/old_configs directory to the /etc/vz/conf directory on the Hardware Node. For example:

```
# cp /etc/vz/conf/old_configs/ve.vps.plesk7.rh9.conf-sample
     /etc/vz/conf
```

After executing these commands, you will be able to use vps.plesk7.rh9 configuration sample in the same way you would use it in Virtuozzo Containers 3.0.

Setting Permissions for Roles in Parallels Infrastructure Manager

A newuser authentication and authorization strategy has been implemented in Virtuozzo Containers 4.0. As a result of this, the roles created on 3.0 Hardware Nodes using Parallels Infrastructure Manager do not include any permissions after upgrading to Virtuozzo Containers 4.0. So, to continue using these roles on Virtuozzo Containers 4.0 Hardware Nodes, you need to edit all roles one by one and set the needed permissions anew. Detailed information on how you can do it is provided in the Managing Virtuozzo Security chapter of the Parallels Infrastructure Manager Administrator's Guide.

Processing Previous Container Requests

In the previous version of Parallels Virtuozzo Containers, Parallels Infrastructure Manager users were able to submit requests for new Containers for themselves. The Hardware Node administrator then could either approve or reject these requests. This functionality has been extended in Virtuozzo Containers 4.0 because Parallels Infrastructure Manager now supports the simultaneous management of a number of Hardware Nodes and users from other domains can now also request Containers for themselves. The by-effect of these enhancements is that if you had not processed (approved or rejected) any Container requests before you upgraded the Node to Virtuozzo Containers 4.0, these requests will not be retained in Infrastructure Manager. So please try to process all such requests before the upgrade.

Requesting Container in Parallels Infrastructure Manager

In previous versions of Parallels Virtuozzo Containers (e.g. in Virtuozzo Containers 3.0 SP1), Container requests are processed as follows:

1 A new user registers in Infrastructure Manager following the Register link on the Infrastructure Manager login screen.
2 After the registration, the user places a Container request.
3 The Hardware Node administrator accepts or denies the Container request.

In Virtuozzo Containers 4.0, the functionality of users self-registering in Infrastructure Manager is not supported any more. Instead of this, the Hardware Node administrator can allow users to request new Containers by completing the following tasks:

1 Register an external database the corresponding user belongs to in Infrastructure Manager.
2 Assign the 'Workflow User' role built-in in Infrastructure Manager to the user.

Detailed information on how to perform both operations is provided in the Managing Virtuozzo Security chapter of the Parallels Infrastructure Manager Administrator' Guide.

Backing Up and Restoring Caches in Virtuozzo Containers 3.0

If you are backing up and restoring Containers with the help of the `vzbackup` utility, it does not back up and restore Container caches by default. However, Container caches do contain Container private files, therefore you may want to back them up as well. This is done with the help of a special switch of the `vzbackup` utility, for example:

```
# vzbackup --vzcache 192.168.20.20 -e 101
```

This command will back up all the cache areas Container 101 is appended to, but not Container 101 itself. In order to back up both the Containers and their caches, you will have to back up the whole Node:

```
# vzbackup 192.168.20.20
```

The restoring of Container caches is performed in much the same way: the `--vzcache` option should be used with the `vzrestore` utility. However, the restoring of the whole Node will not restore the Container caches by default, and you should explicitly provide the `--vzcache` option in all cases.

Detaching Container From Hardware Node Cache Directory in Virtuozzo Containers 3.0

Whereas the `vzcache` utility helps effectively gain disk space both on the Hardware Node and within Containers, there may be situations when it is necessary to detach a Container from its cache and copy the cached files back to the Container private area. A typical example of this is migrating a Container to another Hardware Node. The migration is not possible if there are links in the Container private area pointing to the `/vz/template/vzcaches` directory on the Hardware Node.

To copy the cached files back to the Container private area, the `vzuncache` utility is used:

```
[root@dhcp0-84 root]# vzuncache 101 -a
[Optimization messages skipped...]
Container 101                       53 magic symlinks to convert

Container 101 will be detached from the following caches:
Cache name                                    Size
dhcp0-84.sw.ru-2005030316237                  607972K
```

Now, Container 101 can safely be migrated to another Hardware Node. Note that unlike `vzcache`, the `vzuncache` utility shall be called for only one Container at a time. The `-a` switch tells the utility to detach the Container from all the cache directories specified in its configuration file as the value of the `VZCACHE` parameter.

CHAPTER 11

Advanced Tasks

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Migrating Physical Server to Container

This section provides information on how you can migrate an external physical server to a Container on your Hardware Node.

Migration Overview

Along with migrating Containers between your Hardware Nodes, you may wish to move a stand-alone physical server running a Linux operating system (Fedora Core, Debian, etc.) to a Container on your Node. The migration process includes copying the whole contents of the physical server (i.e. all its files, directories, quota limits, configuration settings, and so on) to a Container on the Hardware Node. After the server migration, you will have its exact copy in a Container including the operating system running inside the Container, the IP address(es) assigned to the Container, the amount of available disk space and memory, etc.

Migration Steps

Before you start migrating a physical server to a Container on the Node, you should have a clear idea of the steps to be performed during the migration. The main steps of the migration procedure may be described as follows:

1 Creating the configuration file containing information on the main resources consumption on the physical server. This file is meant to be used for creating a Container on its basis. The data in the configuration file should be provided in the format readable by Virtuozzo Containers 4.0 (i.e. in the form of `"`*`PARAMETER`*`"="`*`value`*`"`). Among other things, the file should include information on the Linux distribution your physical server is running and the number of user/group IDs allowed for Container internal disk quota. Detailed information on quota limits and Linux distributions is provided in the Managing Resources chapter (p. 116) and in the Linux Distribution Configuration Files subsection of the Parallels Virtuozzo Containers Reference Guide, respectively.

2 Copying the configuration file made on the previous step from the physical server to the Hardware Node. You may copy the configuration file to any directory on the Node; the full path to this file should be specified during the physical server migration.

This step is automatically performed by migrating a physical server to a Container using Virtuozzo Tools (Parallels Management Console and Parallels Infrastructure Manager).

3 Creating a Container on the basis of the configuration file copied to the Node. On this step, you can also specify an OS template to be used for creating the Container. Using an OS template for the Container creation enables you to save RAM and disk space used by this Container on the Hardware Node. In case an OS template is not specified, the `mkvzfs` command is executed during the Container creation which makes an empty private area with the name of `/vz/private/`*`CT_ID`* on the Node. On the next step, all the physical server files including its system and application files will be copied to the `/vz/private/`*`CT_ID`* directory. Detailed information on OS templates is given in Virtuozzo Templates Management Guide.

4 Migrating the physical server to the created Container. During the server migration, the following operations are consecutively performed:

- All the files, directories, etc. are copied from the server to the Container on the Node by means of `rsync` - a utility providing the fast incremental data transfer. For more information on `rsync`, please see the man pages for this utility.
- All the services on the physical server except for the critical ones (e.g. the `sshd` service needed to provide communication between the physical server and the Node) are stopped. This prevents the running services from modifying any files being moved. However, it depends entirely on you what services to stop.

- The files, directories, etc. transferred to the Container during the first `rsync` run are compared with those on the physical server and, if any changes to the files have been made during the files migration, they are copied to the Container once more by means of `rsync` allowing to transfer just the differences between the two sets of files. This step is performed only if you chose the OS template for the Container creation on Step 3.

Note: If the migration process fails on this step, the `/vz/private/`*`CT_ID`* directory on the Hardware Node will contain all the copied files and directories and may occupy a great amount of disk space. You can keep the directory, which will greatly speed up the repeated migration procedure, or manually remove the directory by using the `rm` utility.

---

5 Migrating the disk quota limits imposed on the selected partition from the physical server to the created Container. You may specify only one partition on the physical server which will be migrated to the Container on the Node together with all quotas imposed on it. All the other partitions of the server will be copied without keeping their quota limits. Moreover, the quota limits of the migrated partition will be applied to the entire Container after the server migration. Detailed information on the quota limits is provided in the `vzquota` subsection of the **Parallels Virtuozzo Containers Reference Guide** and in the **Managing Resources** chapter (p. 116).

6 Executing the post-migration scripts depending on the Linux distribution the physical server was running. The names of the scripts to be run are read from the corresponding distribution configuration file in the `/etc/vz/conf/dists` directory on the Hardware Node. The scripts themselves and located in the `/etc/vz/conf/dists/scripts` directory on the Node. They are needed to tune the Container to be able to start it. Any script can be launched by executing the `vzctl runscript` *`CT_ID script_path`* command on the Node where *`CT_ID`* denotes the ID of the Container where the physical server has been migrated and *`script_path`* is the full path to the script on the Node.

7 Stopping the physical server and starting the Container on the Node.

Parallels Virtuozzo Containers allows you to complete all these steps in the following ways:

1 By using the `vzp2v` command line utility;

2 By using Parallels Management Console;

3 By using Parallels Infrastructure Manager.

The aforementioned steps can be automatically performed while running the Management Console and Infrastructure Manager migration wizards. However, if you wish to use the `vzp2v` utility to migrate a physical server to a Container, you should manually create the configuration file by means of the `vzhwcalc` utility and copy it to the Hardware Node before starting the migration process itself. You may also use this utility previous to migrating a physical server in Management Console and/or Infrastructure Manager to find out the resources consumption on the server during its maximal loading and set the right resources parameters on the corresponding steps of Management Console/Infrastructure Manager wizards. Detailed information on the `vzhwcalc` utility and on how to create and modify the configuration file for the Container where your physical server is to be migrated is provided in the **Preparing Container Configuration File** subsection (p. 291).

Besides, while using `vzp2v`, you have to manually stop the physical server and start the Container on the Node after the server migration whereas Management Console and Infrastructure Manager allow you to select the corresponding options on the last step of their wizards.

The migration procedure by means of Management Console and the `vzp2v` utility is described in the following subsections; detailed information on how to migrate a physical server to a Container by using Infrastructure Manager is provided in the **Parallels Infrastructure Manager Administrator's Guide**.

Migration Requirements

To avoid delays and problems while migrating your physical server to a Container on the Node, please make sure that the following requirements are fulfilled in respect of the server and the Hardware Node:

- The physical server is running a Linux distribution (Fedora Core, Red Hat, Debian, SUSE, etc.).

  Note: None of the BSD operating systems is supported.

- The Linux distribution installed on the physical server is supported by Parallels Virtuozzo Containers. To find out if your Linux distribution can be recognized by Virtuozzo Containers 4.0, you can check the `/etc/vz/conf/dists` directory on the Node and look for the configuration file of your Linux distribution. It should have the name of *`Linux_Distribution_Name-version`*`.conf` where *`Linux_Distribution_Name`* and *`version`* denote the name of the Linux distribution running on your physical server and its version, respectively (e.g. `redhat-5.conf`). In case there is no corresponding distribution in the directory, you can proceed in one of the following ways:
  - Create a new distribution configuration file and place it to the `/etc/vz/conf/dists` directory on the Node. Detailed information on how to create new configuration files is provided in the Creating Configuration File for New Linux Distribution section (p. 343).
  - Start the migration process without having the right configuration file for your Linux distribution. In this case the `unknown.conf` distribution configuration file from the `/etc/vz/conf/dists` directory on the Node will be used for tuning the Container after the physical server migration. However, using the `unknown.conf` configuration file means that you will not be able to use standard Virtuozzo utilities (e.g. `vzctl`) for performing the main operations on the created Container (such as setting the Container IP address or configuring the DNS parameters) and have to manually complete these tasks from inside the Container.
- A network connection can be established among the physical server to be migrated and the Hardware Node.
- `ssh` is installed on both the physical server and the Hardware Node. `ssh` is used to provide secure encrypted and authenticated communication between the server and the Hardware Node. You can check if the `ssh` package is already installed on the server by executing the `ssh -V` command.
- `rsync` is installed on the physical server. `rsync` is used to copy the physical server contents to the Container. If the physical server `rsync` happens to be incompatible with the Hardware Node, use the statically linked `rsync` from the `usr/local/share/vzlinmigrate` directory on the physical server as well.
- The Parallels Agent application is started. You can learn if Parallels Agent is running by executing the following command on the Hardware Node:

```
# vzagent_ctl status
vzagent (pid 31556 31555...) is running...
```

  If Parallels Agent is stopped, start it:

```
# vzagent_ctl start
```

- The `vzhwcalc`, `vzlinmigrate`, and `vzlinmigrate-lib` packages are installed on the Hardware Node. During the Virtuozzo 4.0 installation or while upgrading your earlier Virtuozzo Containers version to 4.0, these packages are automatically installed on the Node.

Migration Restrictions

Although Parallels Virtuozzo Containers allows you to migrate virtually any physical server running a Linux distribution to a Container, there is a number of limitations which should be taken into account before deciding on the migration process:

- During the migration, all the filesystems available on your physical server are joined to one filesystem inside the Container - VZFS (Virtuozzo File System). Detailed information on VZFS is provided in the Virtuozzo File System subsection (p. 22).
- If there are several IP addresses assigned to the physical server, all these IP addresses will be reassigned to one and the same device on the Node - `venet0` - a virtual network adapter used to connect all the Containers on the given Hardware Node among themselves and with the Node. After the migration, you can create additional virtual network adapters inside the Container and decide what IP address to be assigned to what network adapter. For detailed information on how to create and manage Container virtual network adapters, please turn to the Managing Virtual Network Adapters section (p. 215).
- During the migration process, you may specify only one partition on the physical server which will be migrated to the Container on the Node together with all quotas imposed on it. All the other partitions of the server will be copied without keeping their quota limits. Moreover, the quota limits imposed on the selected partition will be applied to the entire Container after the server migration.
- While migrating your physical server running a Linux operating system with the security-enhanced (SE) Linux kernel, please keep in mind that the SE Linux kernel is currently not supported by Parallels Virtuozzo Containers. Therefore, the Container where the server running the SE Linux distribution has been migrated will not support the SE security features.
- If any of your files and/or directories on the physical server have extended attributes associated with them, these attributes will be lost after the server migration.
- Raw devices on the physical server cannot and will not be migrated to the Container on the Hardware Node.
- If you are running an application which is bound to the physical server MAC address, you will not be able to run this application inside the Container after the server migration. In this case, you can do one of the following:
  - If you are running a licensed application, you should obtain a new license and install the application inside the Container anew.
  - If you are running a non-licensed application, you can try to reconfigure the application and to make it work without being bound to any MAC address.
- If the migration process fails on the step of transferring files and directories from the physical server to the Container by means of `rsync`, the `/vz/private/`*`CT_ID`* directory on the Hardware Node will contain all the copied files and directories and may occupy a great amount of disk space. You can keep the directory, which will greatly speed up the repeated migration procedure, or manually remove the directory by using the `rm` utility.

Migrating Physical Server to Container in Command Line

Preparing Container Configuration File

If you wish to migrate a physical server to a Container in the command line, i.e. by using the `vzp2v` utility, you should manually create the server configuration file and place it to the Hardware Node before starting the migration process itself. The configuration file contains information on the main server settings: its resource management parameters (e.g. disk space and the number of inodes consumed by the server, the server CPU power), network-related parameters (e.g. the server IP address and hostname), etc. During the physical server migration, information on the resources parameters from the configuration file is used to create a Container on their basis.

To prepare a configuration file for the physical server migration, you should perform the following operations:

- Copy the `vzhwcalc` utility from the Hardware Node to the server; you will need `vzhwcalc` to create the server configuration file.
- Copy the `distdetect-common.sh` script from the Hardware Node to the server; this script is used to determine the Linux version your server is running.
- Create the configuration file by running the `vzhwcalc` utility on the server.
- Edit the configuration file, if needed, and copy it to the Hardware Node.

As a result of the aforementioned operations, a valid configuration file should be created in the format readable by Parallels Virtuozzo Containers and copied to the Hardware Node. This file will be used to create a Container on its basis and the path to the file should be specified as the value of the `-c` option while running the `vzp2v` utility.

Creating Container Configuration File

To create a configuration file of your physical server, you should first copy the `vzhwcalc` utility and the `distdetect-common.sh` script from the Hardware Node to the physical server. By default, `vzhwcalc` and `distdetect-common.sh` are stored in the `/usr/local/bin` and `/usr/local/share/vzlinmigrate` directories on the Node, respectively. The `vzhwcalc` utility is used to create a configuration file containing information on the server main resource parameters and used to create a Container on its basis. In its turn, the `distdetect-common.sh` script is intended to determine what Linux distribution the server is running and to set the value of the `DISTRIBUTION` variable in the generated configuration file in accordance with the detected distribution. You may copy the `vzhwcalc` and `distdetect-common.sh` file to any directory on the physical server.

When launched, the `vzhwcalc` utility scans the main resources on your physical server, makes a snapshot of their consumption, and writes down this information to the server configuration file. Besides, the utility initiates the execution of the `distdetect-common.sh` script used to determine the Linux version installed on your server and to put this information to the generated configuration file.

So, after you have copied the `vzhwcalc` and `distdetect-common.sh` files to the physical server, you should run the `vzhwcalc` utility on it to create a configuration file for your server:

```
# vzhwcalc --scan-time time -p time -d script_path
```

where `--scan-time` is the time during which the `vzhwcalc` utility will be periodically making snapshots of the main server resources, `-p` denotes the interval with which the resources snapshots will be made by the `vzhwcalc` utility, and `-d` is the full path to the `distdetect-common.sh` script on the server. The time and interval should be given in the `dhms` format (e.g. `--scan-time 1d2h30m40s` means that the `vzhwcalc` utility will run on the server for 1 day, 2 hours, 30 minutes, and 40 seconds).

While running the `vzhwcalc` utility, please keep in mind the following:

- The consumption of the resources may significantly vary depending on the server loading. Therefore, we recommend that you set the scan time of the `vzhwcalc` utility to 1 day or more. During this time, the utility will periodically (i.e. with the interval specified) check the resources consumption on the server. As a result, the configuration file will be created on the basis of the peak values reached by the resources during the time specified. By default, all the resource parameters are calculated by `vzhwcalc` with a 150% allowance as compared to their maximal values (except for memory which is calculated with a 120% allowance compared to its maximal value). However, you can use the `--mem-scale` and `--disk-scale` options to set your own enlargement factor by which the calculated memory and disk space resources parameters will be increased in the configuration file.
- After executing `vzhwcalc`, you will be presented with a list of directories on the physical server which are highly recommended to be excluded from the migration process. The names of these directories should be given as the value of the `--exclude` option while running the `vzp2v` utility.
- During the `vzhwcalc` execution, the following warning messages may be displayed:

- A message informing you that the `distdetect-common.sh` script has failed to determine the Linux distribution your physical server is running. In this case you should manually specify your distribution name as the value of the `DISTRIBUTION` variable in the created configuration file. Detailed information on how to work with the `DISTRIBUTION` variable is provided in the next subsection.
- A message informing you that your physical server has two or more network interface cards installed. In this case all IP addresses assigned to several network interfaces on the server will be reassigned to one virtual network adapter on the Node - `venet0`. This virtual adapter will be used by the created Container to communicate with the other Containers on the Node and with the outer world.
- A message containing a list of peer-to-peer IP addresses that cannot and will not be migrated to the Container to be created.
- A message informing you that the Linux OS installed on your physical server supports Native POSIX Thread Library (NPTL). For more information on NPTL, please see the Migration Restrictions subsection (p. 290).

The configuration file created by the `vzhwcalc` utility is placed to the same directory on the physical server from where you have run this utility and has the default name of `ve.conf`. However, you can pass the `-o` option to `vzhwcalc` and set a name of your choice for the resulting configuration file.

Editing Container Configuration File

After you have created the Container configuration file with the default name of `ve.conf`, you should check this file for the resources values listed in it. As has been mentioned above, the resource parameters in the configuration file are calculated on the basis of the physical server maximum load. However, you may wish to increase the resources available (e.g. in case you wish to exploit the Container to be created more intensively than the physical server). You can do it by opening the `ve.conf` file for editing (for example, by means of `vi`) and entering new values for the corresponding parameters.

Along with editing the resource parameters, you should also look for the `DISTRIBUTION` variable in the configuration file used to define what post-migration scripts are to be executed depending on the Linux distribution set in this file:

- If the `DISTRIBUTION` variable is present in the file:
  - Make sure that the distribution configuration file whose name is indicated as the value of the `DISTRIBUTION` variable is present in the `/etc/vz/conf/dists` directory on the Node. All distribution configuration files have `.conf` as their extension added to the corresponding distribution name (e.g. `redhat.conf`).
  - In case there is no corresponding distribution configuration file in the `/etc/vz/conf/dists` directory, create a new distribution configuration file with the name specified as the value of the `DISTRIBUTION` value in the `ve.conf` file and place it to this directory. More information on the distribution file creation see below.
- If the `DISTRIBUTION` variable is absent in the file meaning that the Linux version running on the physical server could not be detected, you should do the following:
  - Create a new distribution configuration file for the Linux version running on the server and place it to the `/etc/vz/conf/dists` directory on the Node.
  - Specify the name of the newly created distribution configuration file as the value of the `DISTRIBUTION` variable in the `ve.conf` configuration file.

Detailed information on how to create new configuration files and set the `DISTRIBUTION` variable is provided in the **Creating Configuration File for New Linux Distribution** section (p. 343).

You can also start the migration process without having the right configuration file for your Linux distribution. In this case the `unknown.conf` distribution configuration file from the `/etc/vz/conf/dists` directory on the Node will be used for tuning the Container after the physical server migration. However, using the `unknown.conf` configuration file means that you will not be able to use standard Virtuozzo utilities (e.g. `vzctl`) for performing the main operations on the created Container (such as setting the Container IP address or configuring the DNS parameters) and have to manually complete these tasks from inside the Container.

Finally, you should copy the resulting configuration file to the Hardware Node. You will have to specify the full path to the configuration file while running the `vzp2v` utility.

Linux distribution installed on the physical server is supported by Parallels Virtuozzo Containers. To find out if your Linux distribution can be recognized by Virtuozzo Containers 4.0, you can check the `/etc/vz/conf/dists` directory on the Node and look for the configuration file of your Linux distribution. It should have the name of *`Linux_Distribution_Name`*`-`*`version`*`.conf` where *`Linux_Distribution_Name`* and *`version`* denote the name of the Linux distribution running on your physical server and its version, respectively (e.g. `redhat-5.conf`).

Migrating Physical Server to Container

Now that you have created the configuration file and copied it to the Hardware Node, you can start the migration procedure itself. To migrate a physical server to a Container, the `vzp2v` utility is used.

Let us assume that you wish to migrate a physical server running the Red Hat Enterprise Linux Server 5 (RHEL 5) operating system and having the IP address of `199.199.109.109` to Container 101 on your Hardware Node; moreover, you are supposed to use the `root` user name and the `3e5rrt4` password to log in to the server. To this effect, you should issue the following command on the Node:

```
# vzp2v root@199.199.109.109 --ctid 101 -c /etc/ve.conf \
-q /private_data -t -d rhel-5 redhat-el5-x86 \
--exclude=/proc/* --exclude=/usr/games -S iptables,crond
```

The options passed to the `vzp2v` utility in the example above are explained in the following table:

Option Name	Description
`--ctid`	Mandatory. The ID of the Container that will be created on the Node and where the physical server will be migrated. You can specify any unoccupied ID on the Node.
`-c`	Mandatory. The full path to the configuration file on the Node that was created on the physical sever by means of the `vzhwcalc` utility. You may specify only the name of the configuration file if you run the `vzp2v` utility from the directory where this file is located.

`-q`, `--quota`	Optional. The partition on your physical server which has any user and/or user groups quotas imposed on it. This partition will be migrated to the Container together with all quotas imposed on it. Moreover, these quotas will be applied to the entire Container after the server migration.
`-d`, `--dist`	Optional. The Linux version your physical server is running. The name of the version specified should coincide with the name of the corresponding distribution configuration file located in the `/etc/vz/conf/dists` directory on the Node. For example, if you specify `rhel-5` as the value of this option, the `rhel-5.conf` file should be present in the `/etc/vz/conf/dists` directory on the Node. You should obligatorily set this option, if there is no `DISTRIBUTION` variable specified in the server configuration file. In case the `DISTRIBUTION` variable is set in the configuration file and you have specified the `-d` option, the latter takes precedence.
`-t, --ostmpl`	Optional. The OS template to be used to create the Container. You may list all OS templates installed on the Node together with their updates by executing the `vzpkgls` command. The names of OS templates usually correspond to those of Linux distributions (e.g. `redhat-el5-x86` as in the example above); so you can easily guess what OS template to use for your Linux distribution. In case an OS template is not specified, the `mkvzfs` command is executed during the Container creation which makes an empty private area with the name of `/vz/private/`*`CT_ID`* on the Node. This private area is then used to copy all the physical server files to it.
`--exclude`	Optional. The path to the directories and files which will be excluded from copying to the Container. This option allows you to avoid migrating the data you do not need. To gain more understanding on this option, please consult the man pages for the `rsync` utility. **Note**: We strongly recommend that you exclude the files and directories you were informed of while running the `vzhwcalc` utility on the physical server.
`-S, --srvstop`	Optional. The services to be stopped for the time of the physical server migration. We recommend that you stop all the services on the physical server except for the critical ones (e.g. the `sshd` service that is needed to provide communication between the physical server and the Node) before the migration. This will prevent the running services from modifying any files being moved.

In the example above, the following operations are performed during the physical server migration:

1. The `vzp2v` utility connects to the physical server with the IP address of `199.199.109.109` by using the `root` user name. While establishing a network connection, you will be asked for the password of `root` to log in to the server and have to enter `3e5rrt4` (which is, in our case, the password of the `root` user).
2. The `/etc/ve.conf` file is read and the `101.conf` file is created on its basis in the `/etc/vz/conf` directory on the Node.
3. Container 101 is created on the basis of the `101.conf` file and the `redhat-el-x86` OS template.
4. All the data except for the `/usr/games` directory and the contents of the `/proc` directory is copied from the physical server to Container 101.
5. The `iptables` and `crond` services are stopped on the physical server.
6. The files copied to Container 101 are compared with those on the physical server and, if any changes to the files were made during the 4th migration step, these changes are copied to Container 101.
7. The quota limits that were imposed on the `/private_data` partition on the physical server are copied to the Container. These quota limits are applied to the entire Container.
8. The post-migration script specific for the RHEL 5 OS is executed. The name of the script to be run is read from the `rhel-5.conf` distribution configuration file located in the `/etc/vz/conf/dists` directory on the Node and is needed to tune the Container before its starting.

Migrating Physical Server to Container in Parallels Management Console

Parallels Management Console provides a special wizard allowing you to quickly and reliably migrate a stand-alone physical server to a Container on your Node. You can launch the Migrate Physical Server to Container wizard by right-clicking the Virtuozzo Containers item under the Hardware Node where you wish to migrate the physical server and choosing Tasks --> Migrate Physical Server to Container on the context menu. You will be presented with the following window:

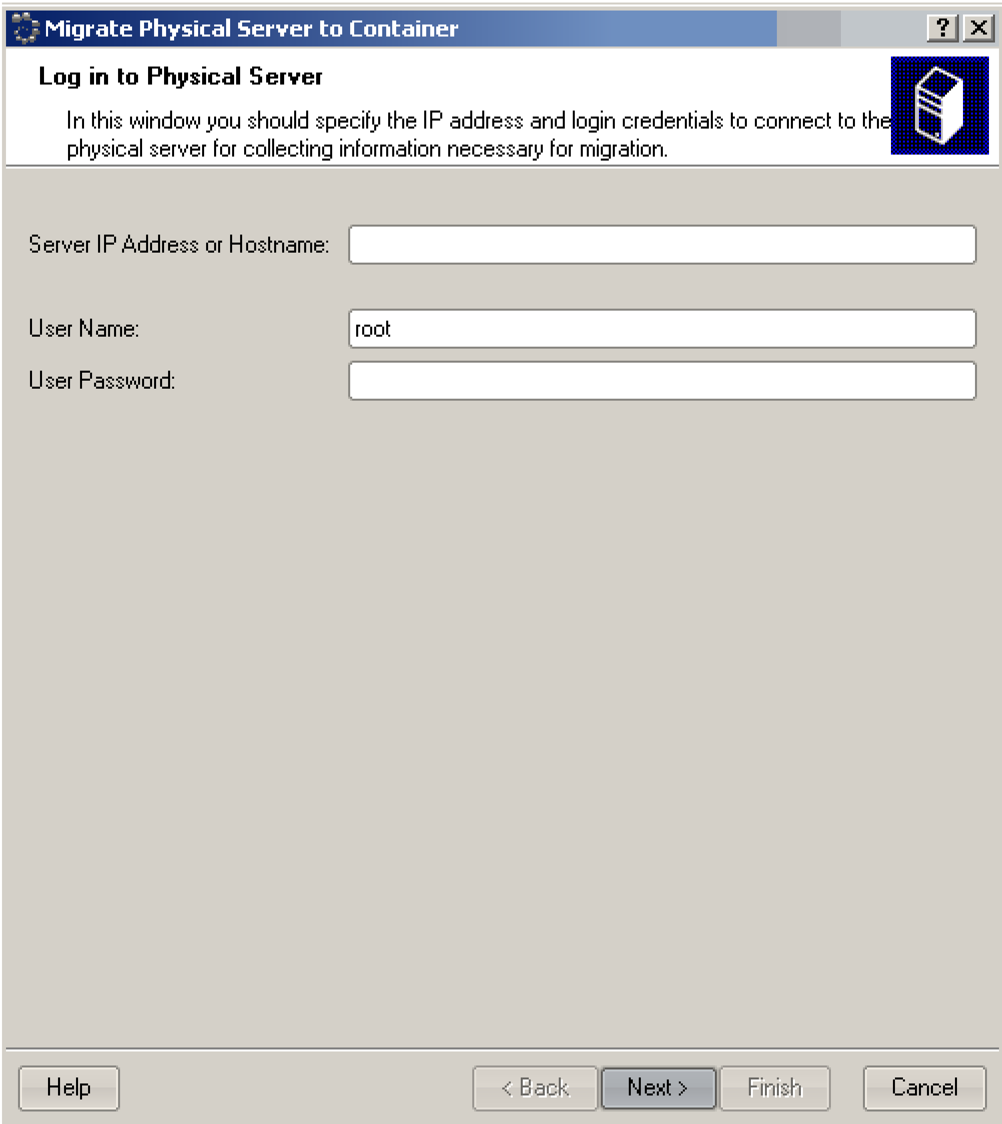

Figure 99: Management Console - Logging In to Physical Server

The information you should enter in the fields provided is presented below:

- Server IP Address or Hostname: the IP address or hostname of the physical server you wish to migrate.

- **User Name**: The user name used to log in to the physical server. You can specify the `root` user in this field, which is offered by default, or may use any other account to log in to the server. However, in the latter case you should make sure that the specified user has all the rights and privileges of the `root` user.
- **User Password**: The password used to log in to the physical server by the user specified in the **User Name** field.

Clicking **Next** in the **Log in Physical Server** window starts the process of connecting to the physical server and collecting information on the server configuration. The process is displayed in the progress bar of the **Collecting Server Configuration** window. After the wizard has successfully connected to the physical server and finished collecting information on its configuration, the following window is displayed:

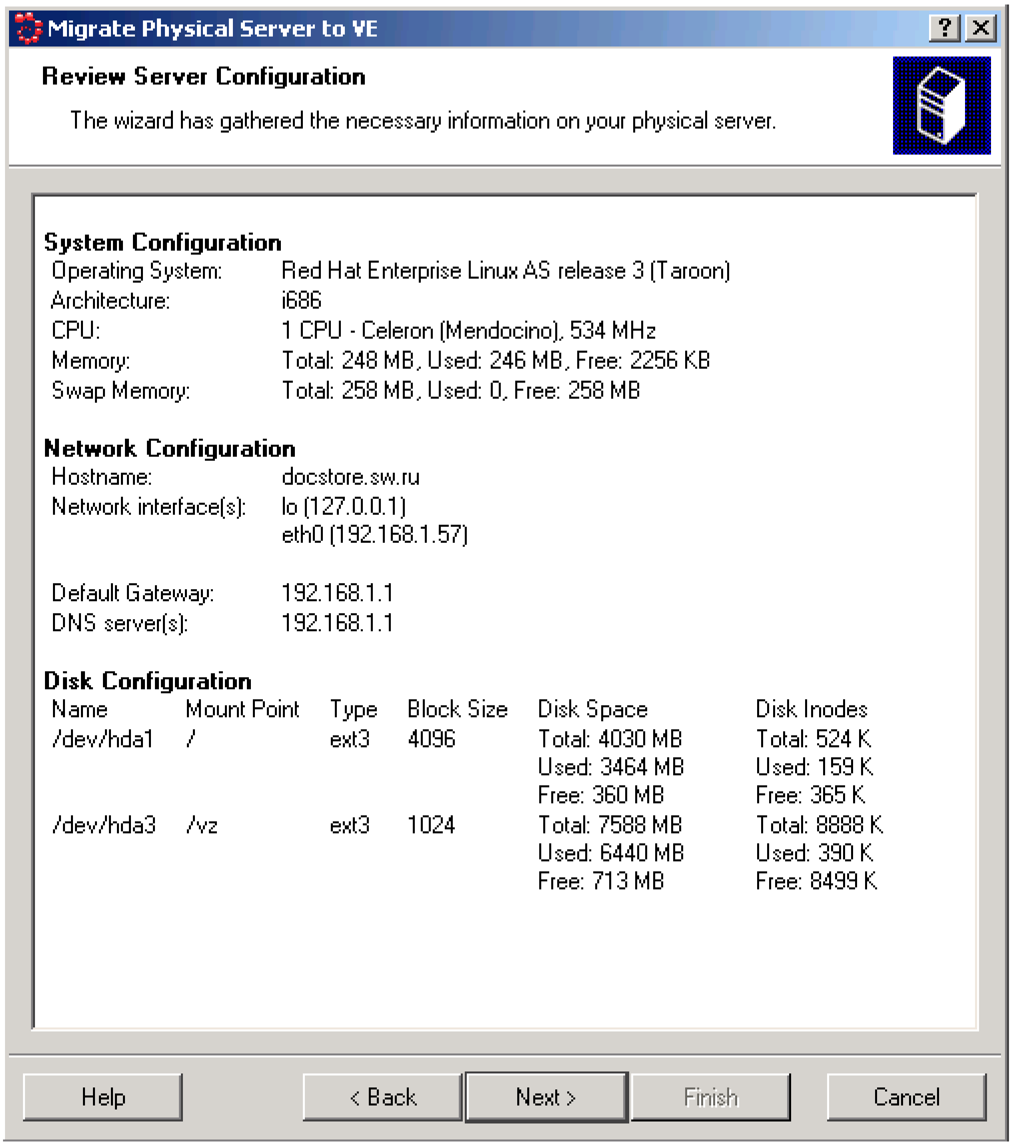

Figure 100: Management Console - Reviewing Physical Server Configuration

The **Review Server Configuration** window allows you to check the configuration of the server you are going to migrate into a Container. The information on the server is divided into three groups for your convenience:

- The **System Configuration** group including information on the operating system the server is running, the number and power of the processor(s) installed on the server, etc.
- The **Network Configuration** group containing information on the server hostname, the IP address(es) of the default gateway used by the server to access other networks, and so on.
- The **Disk Configuration** group holding data on the partitions that the physical server has: their name, type, disk space, etc.

After you have reviewed the information on the physical server configuration and clicked **Next**, the **Customize Server Migration** window is displayed:

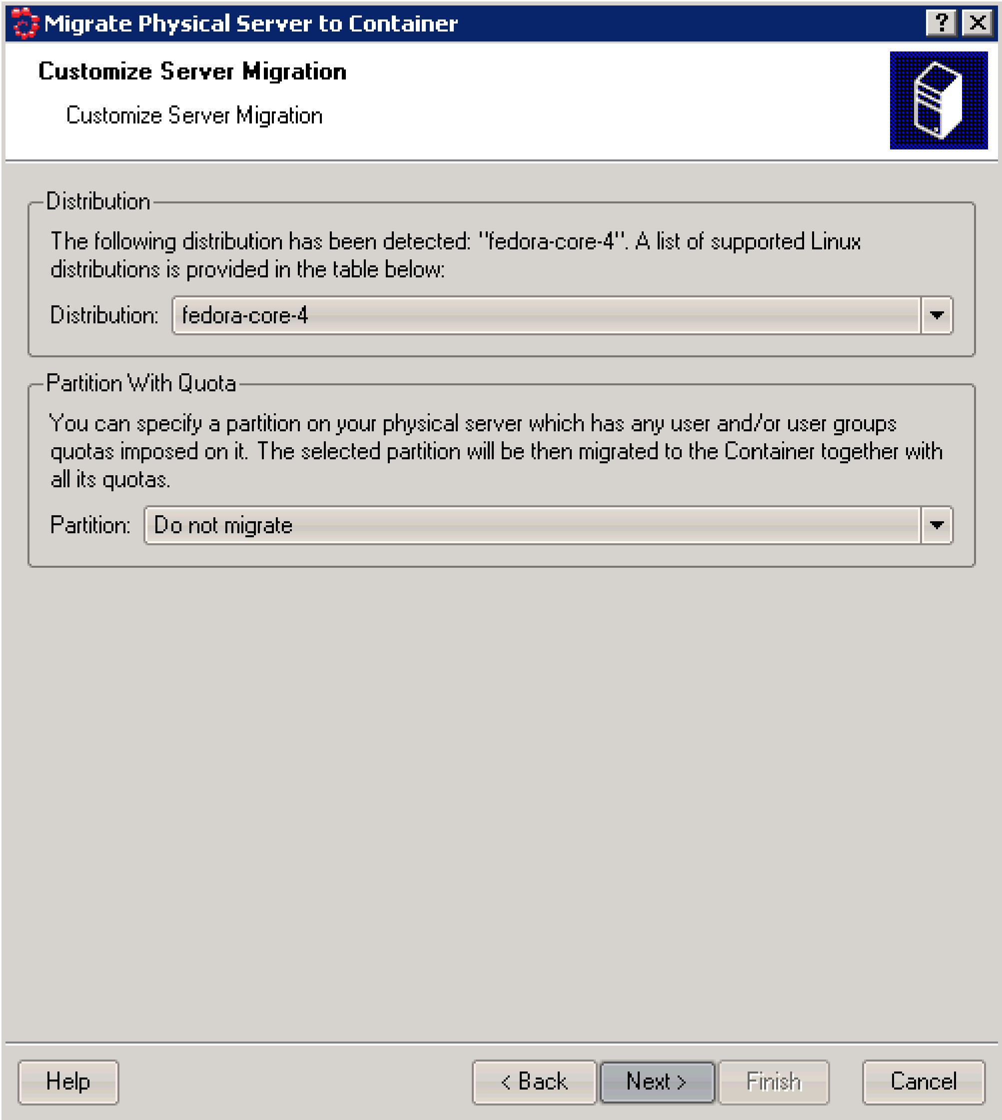

Figure 101: Management Console - Customizing Server Migration

In this window, you can perform the following operations:

- In the **Distribution** field, indicate the Linux distribution your physical server is running by selecting the right Linux version on the drop-down menu. The wizard tries to automatically determine the Linux distribution installed on your server and to offer the most suitable variant. If the wizard cannot specify what Linux distribution your server is running, the value of this field is set to "unknown". In this case you should manually select the corresponding Linux distribution on the drop-down menu; otherwise, you may get your Container in an non-operational state after the physical server migration. In case you cannot find the right distribution on the drop-down menu, you can proceed in one of the following ways:
  - Select the most suitable distribution available on the Node. For example, if your physical server is running Fedora 8, you can choose `fedora-core-8` (the distribution configuration file for Fedora 8) or, if the latter is also lacking, `fedora-core` (the generic configuration file for all Fedora Core distributions). However, there is a slight chance that your Container may not work properly due to some differences, which might be present in one and absent in another Linux version.
  - Create a new distribution configuration file and place it to the `/etc/vz/conf/dists` directory on the Hardware Node. However, to be able to select this configuration file on the drop-down menu in the **Distribution** field, you should log off and log in to the physical server anew. You can do it either by closing the wizard and starting it again or by clicking on the **Back** button until you return to the **Login to the Server being Migrated** window and then proceeding with the wizard in the way described above. Detailed information on how you can create new distribution configuration files is provided in the **Creating Configuration File for New Linux Distribution** section (p. 343).
- In the **Partition** field, specify a partition on your physical server which has any user and/or user groups quotas imposed on it by selecting the right partition on the drop-down menu. The selected partition will be then migrated to the Container together with all quotas imposed on this partition. Moreover, the quota limits that were imposed on the selected partition on the physical server will be applied to the entire Container after the server migration. For example, you might have created a number of user accounts having access to a certain partition on your physical server and set the maximal amount of disk space these users are allowed to consume within this partition. Specifying the name of this partition in the **Partition** field allows you to move the partition to the Container and to keep all users disk space quotas imposed on it.

Note: 1. If your physical server has several partitions with quota parameters imposed on them, the quota parameters for all the partitions other than the one indicated in the **Partition** field will not be migrated. In this case you will need to manually set the corresponding quotas by means of Parallels Management Console or special Virtuozzo command line utilities after the physical server migration. Detailed information on how to manage the Container quota parameters is provided in the **Managing Disk Quotas** section (p. 117).

2. Although the partition migration with quotas proceeds smoothly in most cases, we recommend that you check all the partition quotas after the physical server migration and adjust them, if needed.

When you are ready with specifying the right Linux distribution and partition, click **Next**.

The next screen allows you to exclude certain files and directories on the physical server from being migrated to the Container and, thus, to avoid copying the data you do not need. You may be already presented with a list of files and directories that are to be excluded from the migration process and that were automatically generated by the wizard. You can also use the **Browse** button in the right part of the **Select Files and Folders to Exclude from Migration** window to additionally specify the files and directories you wish to exclude from being moved to the Container. Click **Next**.

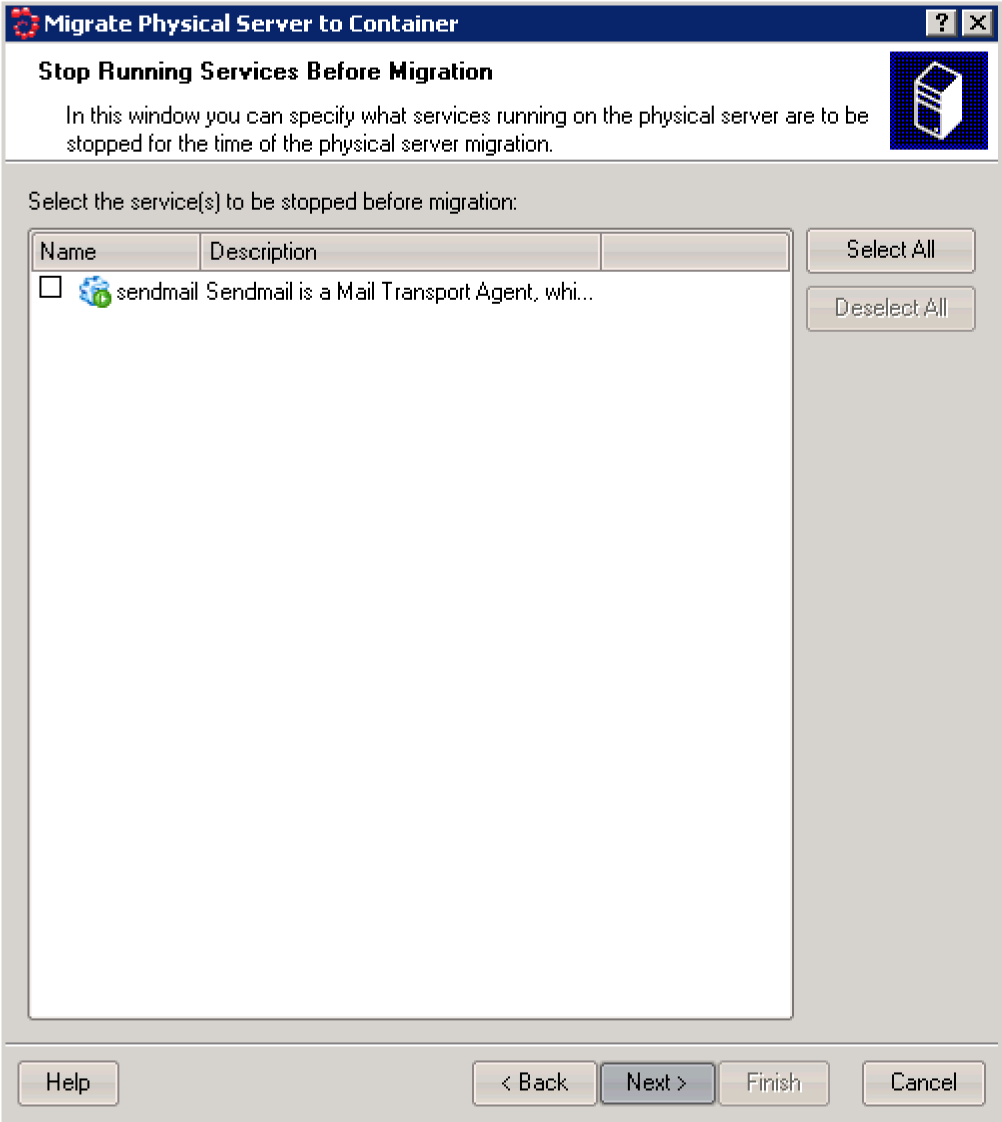

Figure 102: Management Console - Stopping Services

The next screen allows you to specify the Container main parameters:

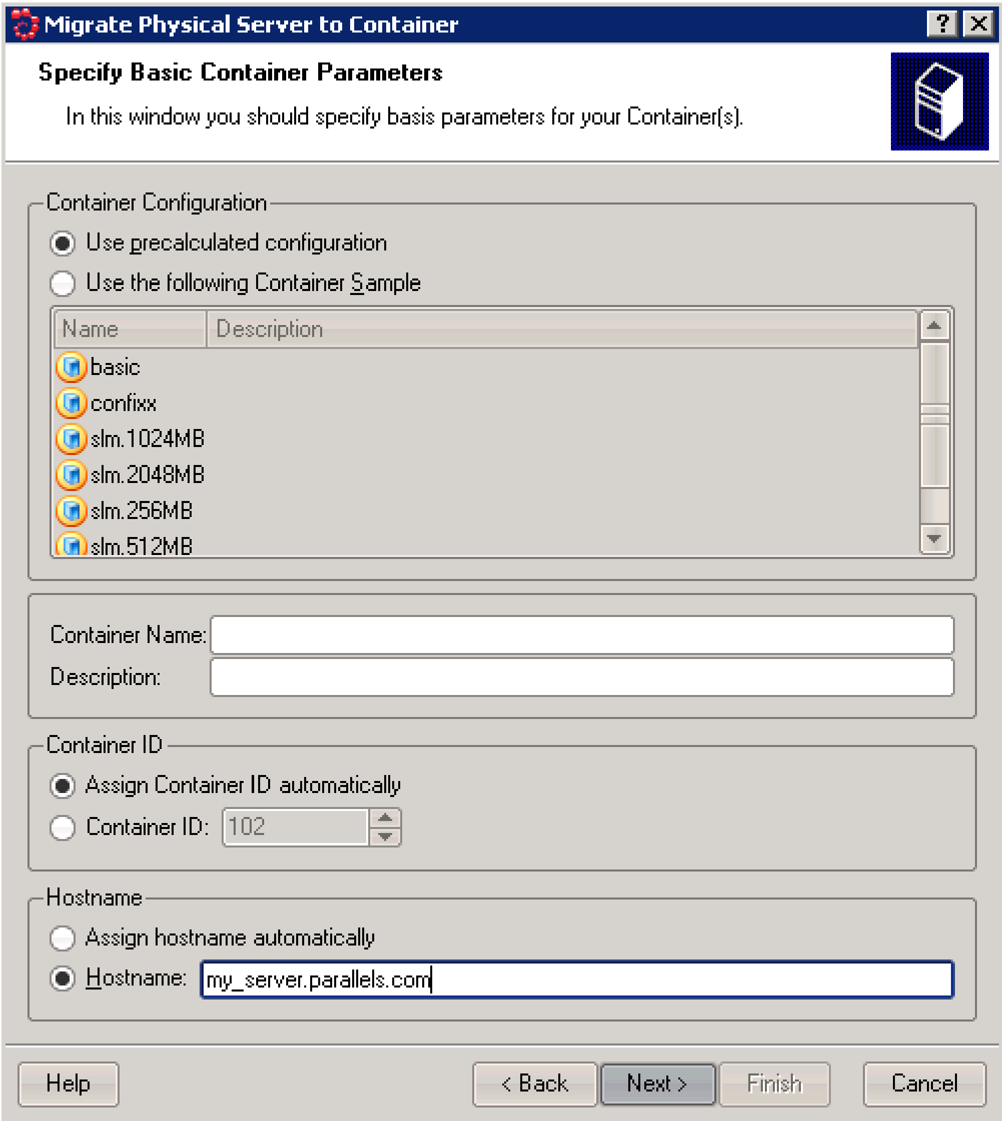

Figure 103: Management Console - Specifying Container Basic Parameters

In this window you can do the following:should provide information in the following fields:

- Select the **Use precalculated configuration** check box to create the Container by using the configuration file that was automatically generated by the wizard on the basis of the resources consumption on your physical server.
- Select the **Use following Container sample configuration** check box to create the Container on the basis of one of the Container configuration sample files available on your Node. All the Container sample files you can choose from are listed in the table in the centre of the displayed window. Detailed information on Container configuration sample files is provided in the **Managing Container Resources Configuration** section.
- **Container ID**: enter the ID of the Container which will be created on the Node and where the physical server will be migrated. Make sure that there is no Container on the Node with the ID specified in this field.
- **Hostname**: enter the hostname of the Container which will be used to identify the Container on a network.

After you have selected the corresponding check box and specified the Container ID and hostname, click **Next**.

The **Specify OS Template** window allows you to choose an OS template and its version the Container will be based on. By default, Parallels Management Console automatically searches for the most compatible OS template. However, you can select any OS template listed in the table on this screen and create the Container on its basis.

Clicking **Next** on the **Specify OS Template** screen displays the window where you are asked to specify the Container network parameters:

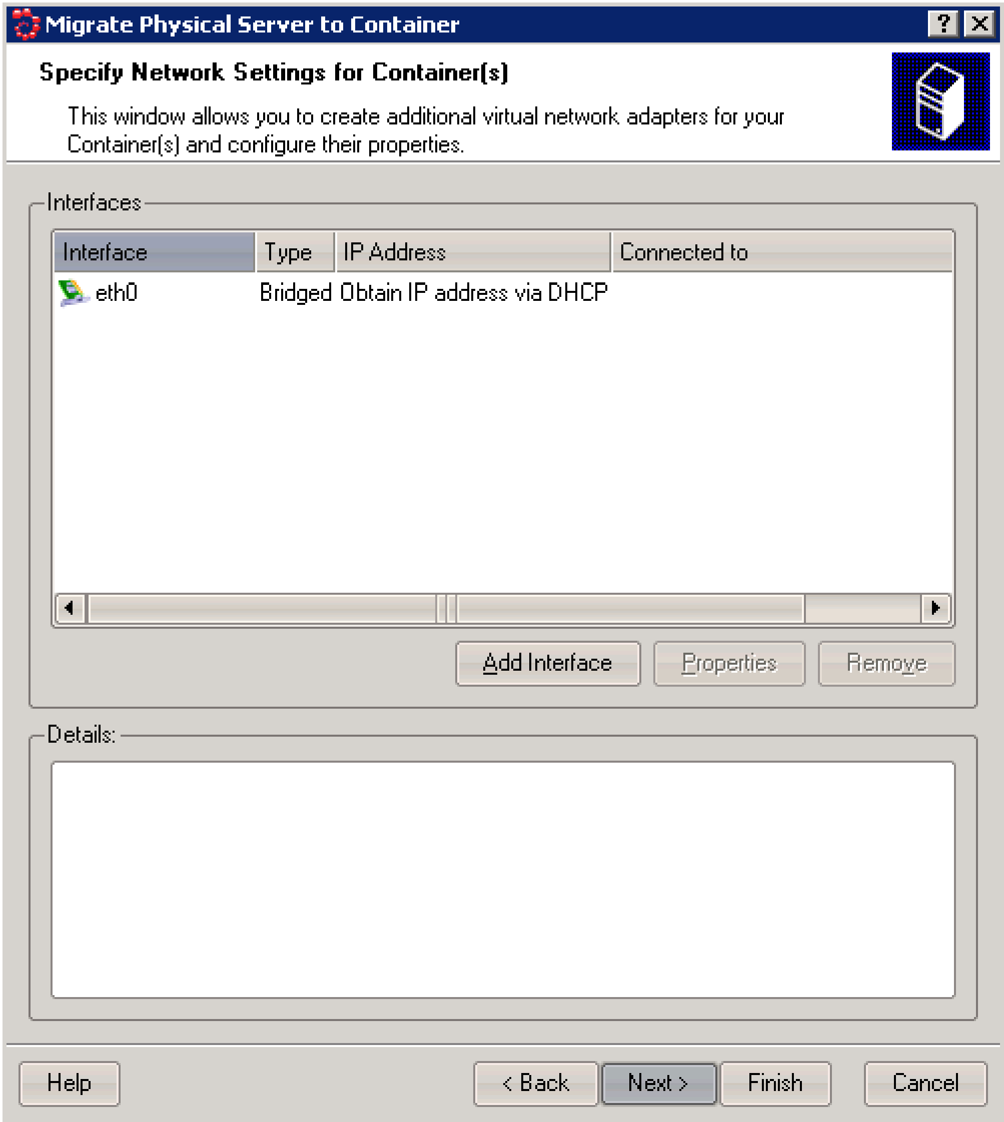

Figure 104: Management Console - Defining Network Parameters

In this window you can do the following:

- View and configure the settings of the `venet0` virtual network adapter that will be created inside the Container. `venet0` is the default network adapter created inside each Container on the Node. You can change the IP address to be assigned to the `venet0` adapter (by default, the IP address of the physical server is set) by selecting the adapter name in the **Interfaces** table, clicking the **Properties** button, and, in the displayed window, entering the needed IP address(es).
- Create additional virtual network adapters for the Container by clicking the **Add Interface** button and entering the necessary information in the displayed window. For example, if the physical server has obtained its TCP/IP-settings through the DHCP protocol, you may need to create a new virtual network adapter, set it to work in the bridged mode, and attach the adapter to the corresponding physical network adapter on the Node to provide network connectivity for the resulting Container. For detailed information on how to create and manage Container virtual network adapters, please turn to the **Managing Virtuozzo Network** chapter (p. 205).

On the next step, you can specify a number of additional network settings for the Container:

Figure 105: Management Console - Specifying Additional Network Parameters

In this window you can use the provided **Add**, **Remove**, and **Edit** buttons for the corresponding operations on Container DNS servers and search domains.

After you have set the Container network parameters, click **Next** to open the window allowing you to adjust the resources parameters for the Container:

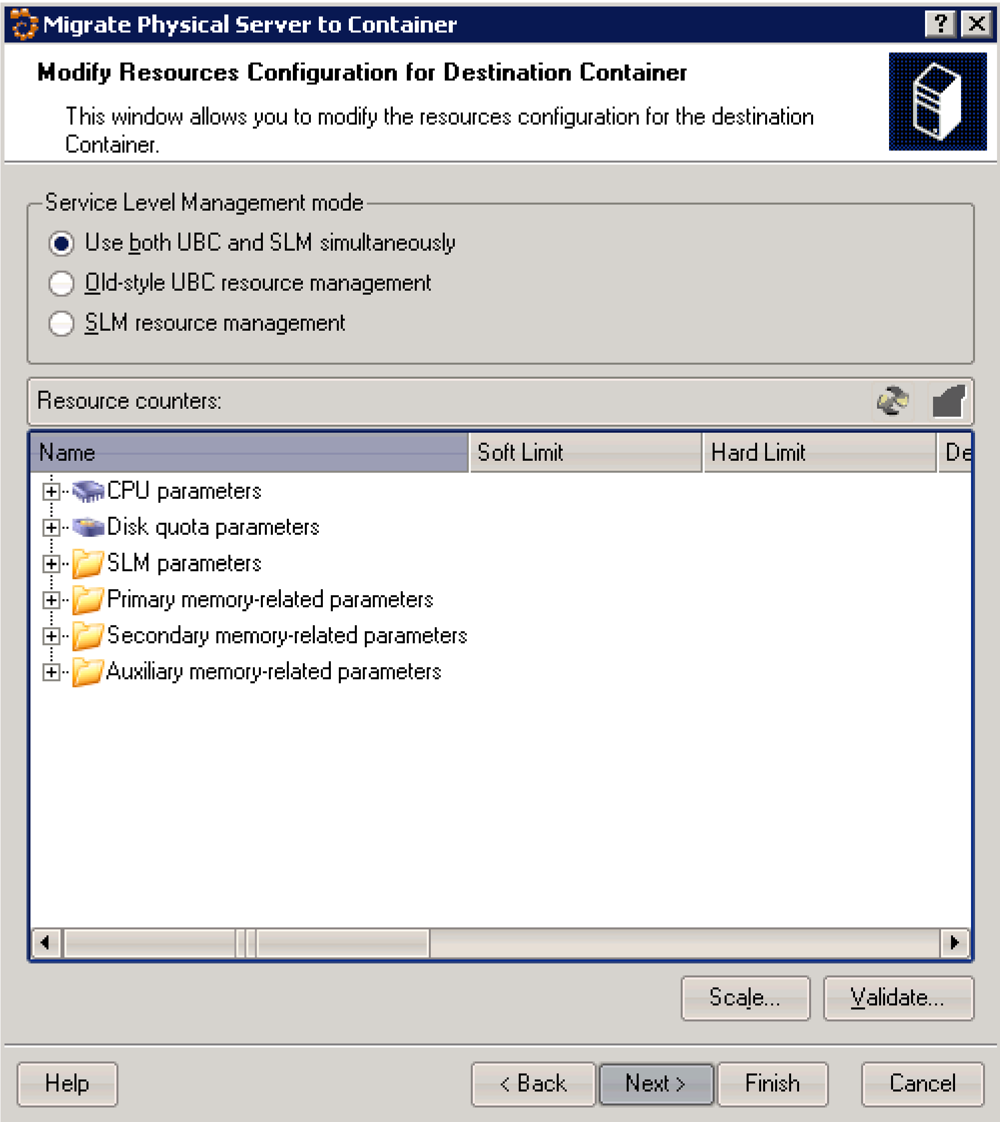

Figure 106: Management Console - Specifying Resource Parameters

All the resources are grouped by their relations to several subsystems for you to easier find information on the resource that interests you: **CPU parameters**, **Disk Quota parameters**, **Primary UBC parameters**, **Secondary UBC parameters**, **Auxilary UBC parameters**, and **New SLM parameters**. The information on the Container parameters is presented in the table having the following columns:

Column Name	Description
Name	The name of the resource parameter.

Soft Limit	The quota on the consumption of the given resource by the Container. In some situations, the system may allow the Container to exceed this quota up to the limit.
Hard Limit	The quota on the consumption of the given resource by the current Container that cannot be exceeded in any circumstances.
Description	The concise description of the given resource.

When setting Container system management parameters, you can choose one of the following options:

- Select the **Memory-related parameters** button to use UBC parameters to manage Container system resources. Detailed information on all UBC parameters is provided in **Managing UBC Resources in Parallels Virtuozzo Containers** shipped with Virtuozzo Containers 4.0.
- Select the **New Service Level Management** parameters to use SLM parameters to manage Container system resources. Detailed information on these parameters is given in the **Managing System Parameters** section (p. 150).
- Select the **All parameters** radio button to manage Container system resource using both UBC and SLM parameters.

All the resource parameters shown in the table are calculated with a 150% allowance as compared to their original values (except for memory which is calculated with a 120% allowance to its original value), i.e. to those values that were collected by the wizard while scanning your physical server. However, you should keep in mind that the resources consumption on the physical server may significantly differ depending on its loading. So, you may need to increase the Container resources parameters by double-clicking them and entering new values in the appropriate fields.

Note: While defining the right resources parameters, you can resort to the help of the `vzhwcalc` utility allowing you to scan the main resources on the physical server for a long period of time and to find out their consumption during its maximal loading. Detailed information on this utility is given in the **Creating Container Configuration File** subsection (p. 291).

In the **Modify Resources Configuration for Destination Container** window, you can also use the **Scale Configuration** and **Verify Configuration** buttons at the foot of the page to scale and verify the configuration of the Container, respectively. For information on how to scale and validate your existing configuration see the **Managing Container Resources Configuration** section (p. 158). After you have made the necessary changes, click **Next.**

The last screen of the wizard allows you to review the migration settings made on the previous steps. You can also compare the configuration of the physical server to be migrated with that of the Container to be created. Besides, you can select the **Shut down server and start Container after migration** check box at the bottom of the screen to automatically stop the physical server and start the Container after migration. This may be necessary to avoid the conflict of the physical and virtual servers due to the identical network settings. If you are satisfied with the parameters set, click **Finish** to start migrating the physical server to the Container.

Note: If you click **Cancel** on certain steps, and the migration wizard exits, there may remain a temporary directory on the physical server that you should remove manually. The name of the directory is `/var/vzagent.tmp`.

Migrating Container to Physical Server

You may also wish to migrate an existing Container on your Node to a physical server on a network. For example, this may be useful in case you migrated your physical server to a Container on the Node, performed some operations on/inside this Container (i.e. changed the content of some folders and directories), and now wish to move all the data (intact and changed) back from the Container to the server.

Note: User quotas inside the Container are not migrated to the physical server in the current Virtuozzo Containers version.

Migration Steps

The main steps performed while migrating a Container to a physical server are the following:

1. A network connection is established between the Hardware Node and the physical server.
2. The Container to be migrated is set in the "stopped" and "mounted" states, in case it is running or stopped and unmounted.
3. A list of files and directories to be automatically excluded from the migration process is generated. The script used to create such a list depends on the Linux distribution the Container is running. The name of the script is read from the distribution configuration file in the `/etc/vz/conf/dists` directory and the script itself is located in the `/etc/vz/conf/dists/scripts` directory on the Node. You can also specify additional files and directories that you do not wish to move to the physical server.
4. The files, directories, libraries, etc. are copied from the Container to the physical server by using `rsync`. This utility allows you to transfer only the differences between the two sets of files, which significantly speeds up the process of copying data between the Container and the server in case they differ only slightly from each other.
5. The `ldconfig` command is executed on the physical server. This command examines the copied shared libraries, if any, in the `/usr/local/lib`, `/usr/lib`, and `/lib` directories on the server and in the directories specified in the `/etc/ld.so.conf` file and updates the links and cache to these libraries. For more information on `ldconfig`, please see the man pages for this command.

The `vzv2p` utility used to migrate a Container to a physical server allows you to automatically complete all the aforementioned tasks except for the last one, i.e. you have to manually run the `ldconfig` command on the server after the Container migration.

Migration Requirements

Before starting the migration process, please make sure that your physical server and Container meet the following requirements:

- A Linux distribution (Fedora Core, SUSE, Debian, etc.) is installed on your physical server. This distribution should correspond to that running inside the Container you are going to migrate.
- A network connection can be established among your physical server and the Hardware Node.
- `ssh` is installed on both the physical server and the Hardware Node. `ssh` is used to provide secure encrypted and authenticated communication between the server and the Hardware Node. You can check if the `ssh` package is already installed on the server by executing the `ssh -V` command.
- `rsync` is installed on the physical server. `rsync` is used to copy the Container contents to the physical server. If the physical server `rsync` happens to be incompatible with the Hardware Node, use the statically linked `rsync` from the `usr/local/share/vzlinmigrate` directory on the physical server as well.
- The distribution configuration file for the Linux distribution running inside the Container to be migrated is present in the `/etc/vz/conf/dists` directory on the Node. The `DISTRIBUTION` variable in this file specifies what script is to be used to generate a list of files and directories, which will not be moved from the Container to the physical server.

Migrating Container to Physical Server

To migrate a Container to your physical server, the `vzv2p` utility is used. Let us assume that you migrated your physical server to Container 101 three months ago, the Container was on the go during all this time (i.e. some of the old files and directories were changed, certain configuration settings modified, etc.), and now you wish to move Container 101 back to your physical server. To this effect, you should issue the following command:

```
# vzv2p root@199.200.200.200 --ctid 101 \
--exclude /home/private
```

The options passed to the `vzv2p` utility in the example above are explained in the following table:

Option Name	Description
`--ctid`	The ID of the Container on the Node to be migrated to the physical server.
`--exclude`	The directories to be excluded from being copied to the Container. This option allows you to avoid migrating the data you do not need.

In our example, the vzv2p utility connects to the physical server with the IP address of 199.199.109.109 by using the root user name. While establishing a network connection, you will be asked for the password of root to log in to the server and have to enter 3e5rrt4 (which is, in our case, the password of the root user). After that, Container 101 is brought to the "stopped" and "mounted" state and all the data except for the /home/private directory and directories that were automatically generated by the script defined on the basis of the DISTRIBUTION variable in the Container configuration file is copied from Container 101 to the physical server.

After the Container has been successfully migrated to the physical server, you should execute the ldconfig command to update the links and cache to the shared libraries on the server.

Creating Customized Containers

If you wish to run one or several customized applications inside your Containers and the number of such Containers is relatively large, you may think of a way to automate the process of creating Containers that already have a number of applications installed and tuned to meet your demands. So, you do not need to manually install and customize your applications every time you create a new Container.

Parallels Virtuozzo Containers allows you to create customized Containers having a certain set of customized applications installed inside them right after their creation in one of the following ways:

- By making a customized base OS EZ template and using it as the basis for your Containers.
- By making a non-base OS EZ template and using it as the basis for your Containers.
- By making a customized application EZ template, adding it to a new configuration sample file, and using this sample file as the basis for your Containers.

All these operations are described in the following subsections in detail.

Using Customized OS EZ Template

Let us first start with making a customized base OS EZ template which can then be used to create Containers with a set of application already tuned to meet your demands. To make such a template, you should perform the following operations:

1 Create a metafile that will serve as the basis for your customized base OS EZ template.

Notes: 1. Detailed information on how to create metafiles is given in the Creating Metafile for EZ Template subsection of the Parallels Virtuozzo Containers Templates Management Guide.

2. While creating a metafile for your new OS EZ template, you should make sure that the value of either the %osname parameter or the %version parameter in the metafile differs from the names or versions of all base OS EZ templates installed on the Hardware Node. So, if the base RHEL4 OS EZ template is already installed on your Node, these values cannot be simultaneously set to redhat and as4.

2 Create one or more scripts that will be executed on different stages of the OS EZ template lifecycle and customize your application(s) to meet your needs. For example, you can create a postinstall script with the name of `post_install.bash` and make it perform a number of customization operations on some application included in the OS EZ template after installing this application inside your Container.

3 Create a customized OS EZ template by running the `vzmktmpl` utility and passing the corresponding options to it. So, you can use the `--post-install` option and specify the path to the `post_install.bash` script from the example above to make an OS EZ template that will customize your application after installing it inside your Container.

Note: The full list of options allowing you to specify what scripts are to be executed on what stage of the EZ template lifecycle is provided in the vzmktmpl subsection of the Parallels Virtuozzo Containers Reference Guide.

4 Install the customized OS EZ template on the Hardware Node by using the `rpm -i` command.

5 Cache the created OS EZ template by running the `vzpkg create cache` command. Detailed information on how you can do it is provided in the Preparing OS EZ Template for Container Creation section.

6 Create a Container based on the OS EZ template.

For example, to create a Container which will run Red Hat Enterprise Linux 4 (RHEL 4) and have the customized `mysql` and `apache` applications installed inside it right after its creation, you should do the following:

1 Create a metafile for the RHEL 4 OS EZ template, name it, for example, `rhel_4_customized.metafile`, and save in the `/root/rhel4` directory on the Hardware Node.

2 Make a script that will perform a number of custom operations after applying the `mysql` and `apache` application EZ templates to the Container and name it `post_install.bash`.

3 Copy the script to the `/root/rhel4` directory on the Hardware Node.

4 Execute the following command on the Node to create the RHEL 4 OS EZ template:

```
# vzmktmpl /root/rhel4/rhel_4_customized.metafile \
          --post-install /root/rhel4/post_install.bash
```

This command will create an OS EZ template for RHEL 4 and put it to the `/root` directory on the Hardware Node (e.g. `/root/redhat_customized-as4-x86-ez-4.0.0-1.swsoft.noarch.rpm`).

5 Install the resulting OS EZ template on the Hardware Node:

```
# rpm -i /root/redhat_customized-as4-x86-ez-4.0.0-1.swsoft.noarch.rpm
```

6 Cache the installed OS EZ template:

```
# vzpkg create cache redhat_customized-as-x86
...
Complete!
Packing cache file redhat_customized-as4-x86.tar.gz ...
Cache file redhat_customized-as4-x86.tar.gz [14M] created.
```

7 Create Container 101 on the basis of the new OS EZ template:

```
# vzctl create 101 --ostemplate redhat_customized-as4-x86
                     -–config basic
Creating Container private area (redhat_customized-as4-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area was created
Delete port redirection
Adding port redirection to Container(1): 4643 8443
```

So, you have just created Container 101 having the customized `mysql` and `apache` applications installed inside it.

Using EZ OS Template Set

Another way of creating customized Containers is to make a non-base OS EZ template (also known as an OS EZ template set) differing from the corresponding base OS EZ template in the number of packages included in this template. For example, if you wish your Container to run Red Hat Enterprise Linux 4 and to function as a Linux-based server only, you can create the `redhat-as4-x86-server` OS EZ template set and include only those packages in it that are needed for performing main server tasks. So, you can specify packages to be used for setting up file and print sharing and exclude all the packages for graphical interfaces (GNOME and KDE).

To create a non-base OS EZ template, you should complete the following tasks:

1 Create a metafile that will serve as the basis for your non-base OS EZ template. Any metafile for this kind of EZ template should contain the following information:

- `%osname`: the name of the Linux distribution for which you are creating the OS EZ template set. This name should correspond to that specified in the base OS EZ template. For example, if you are creating an OS template set of the base OS EZ template for RHEL 4, you should set the value of this parameter to `redhat`.
- `%osver`: the version of the Linux distribution specified as the value of the `%osname` parameter. This name should correspond to that specified in the base OS EZ template. For example, if you are creating an OS template set of the base OS EZ template for RHEL 4, you should set the value of this parameter to `as4`.
- `%osarch`: The microprocessor architecture where the EZ template is to be run. This name should correspond to that specified in the base OS EZ template. For example, if you are creating an OS template set of the base OS EZ template for RHEL 4, you should set the value of this parameter to `x86`.
- `%setname`: the name to be assigned to your non-base OS EZ template. You can specify any name you like for your OS template set:

a This name will be added to the name of the base OS EZ template after the indication of the architecture where the OS EZ template is to be run. For example, if you are creating an OS template set of the base OS EZ template for RHEL 4 which is supposed to run on x86 platforms, the name of your non-base OS EZ template may look like the following - `redhat-as4-x86-`*`Template_Name`*`-ez-1.0-1.noarch.rpm` - where *`Template_Name`* is the name you specify as the value of the `%setname` parameter.

b This name will also be assigned to the directory which will store the meta data of your non-base OS EZ template after the template installation on the Hardware Node. For example, it will have the name of `/vz/template/redhat/as4/x86/config/os/my_non_base_template/` after you set the value of this parameter to `my_non_base_template`, created a non-base OS EZ template for RHEL 4, and installed it on the Node.

- `%packages`: a list of RPM packages to be included in the non-base OS EZ template. This parameter allows you to specify what applications will be present inside your Containers based on this OS EZ template set right after their installation. The names of the packages listed as the value of this parameter should correspond to the names of real RPM packages (without indicating the package version, release, architecture, and the `.rpm` extension) that are stored in the repository used for managing your EZ templates.

Note: You can also specify a number of additional parameters in your metafile. For example, you may wish to add one or several extra packages to your OS EZ template set which are not available in the repository used to handle the packages for the corresponding base OS EZ template. For this purpose, you will have to specify the `%mirrorlist` parameter providing information on the repository where these extra packages are kept. Detailed information on all parameters you can set in metafiles is given in the Parallels Virtuozzo Containers Reference Guide.

2 You can also (although you do not have to) create a number of scripts that will be executed on different stages of the non-base OS EZ template lifecycle and customize your application(s) to meet your demands. The path to these scripts should then be specified after the corresponding options while creating your OS template set. For example, you can create a preinstall script with the name of `pre_install.bash` and make it perform a number of customization operations on some application included in the non-base OS EZ template before installing this application in your Container.

Note: If there are no scripts for the non-base OS EZ template, the corresponding scripts available for the base OS EZ template will be executed.

3 Create the non-base OS EZ template by running the `vzmktmpl` utility and passing the corresponding options to it, if needed. So, if you created one or several scripts on the previous step, you can use special options and specify the path to these scripts during the command execution. For example, you can use the `--pre-install` option and specify the path to the `pre_install.bash` script to make an OS EZ template that will customize your application before installing it inside your Container.

Note: The full list of options allowing you to specify what scripts are to be executed on what stage of the EZ template lifecycle is provided in the vzmktmpl subsection of the Parallels Virtuozzo Containers Reference Guide.

4 Install the non-base OS EZ template on the Hardware Node by using the `rpm -i` command.

5 Cache the created OS EZ template by running the `vzpkg create cache` command. Detailed information on how you can do it is provided in the **Preparing OS EZ Template for Container Creation** section of the **Parallels Virtuozzo Containers Templates Management Guide**.

6 Create a Container based on the OS EZ template.

Using Customized Application Template

If the number of customized applications inside your Containers is relatively small, you can also use the following way of creating customized Containers:

1 Create a metafile that will serve as the basis for your customized application EZ template.

Note: Detailed information on how to create metafile is given in the **Creating Metafile for EZ Template** subsection of the **Parallels Virtuozzo Containers Templates Management Guide**.

2 Create one or more scripts that will be executed on different stages of the application EZ template lifecycle and customize your application(s) to meet your demands. For example, you can create a postinstall script with the name of `post_install.bash` and make it perform a number of customization operations on your application after installing this application in your Container.

3 Create a customized application EZ template by running the `vzmktmpl` utility and passing the corresponding options to it. So, you can use the `--post-install` option and specify the path to the `post_install.bash` script from the example above to customize your application in accordance with your needs after installing it in your Container.

Note: The full list of options allowing you to specify what scripts are to be executed on what stage of the EZ template lifecycle is provided in the **vzmktmpl** subsection of **Parallels Virtuozzo Containers Reference Guide**.

4 Install the customized EZ template on the Hardware Node by using the `rpm -i` command.

5 Create a new Container configuration sample file and include the customized EZ template in this file. Detailed information on Container configuration sample files is provided in the Managing Container Resources Configuration section (p. 158).

6 Create a customized Container on the basis of the configuration sample.

The following example demonstrates how to create Container 101 which will run Red Hat Enterprise Linux 4 and have the customized `mysql` application installed inside it right after its creation:

1 Create a metafile for the `mysql` application, name it `mysql.metafile`, and save in the `/usr/mysql` directory on the Hardware Node.

2 Make a script that will perform a number of custom operations after applying the `mysql` EZ template to the Container and name it `post_install.bash`.

3 Copy the script to the `/usr/mysql` directory on the Hardware Node.

4 Execute the following command on the Node to create the `mysql` EZ template:

```
# vzmktmpl /usr/mysql/mysql.metafile \
          --post-install /usr/mysql/post_install.bash
```

This command will create an EZ template for the `mysql` application and put it to the `/root` directory on the Hardware Node (e.g. `/root/mysql-redhat-as4-x86-ez-4.0.0-1.swsoft.noarch.rpm`).

5 Install the `mysql` EZ template on the Hardware Node:

```
# rpm -ihv /root/mysql-redhat-as4-x86-ez-4.0.0-1.swsoft.noarch.rpm
```

6 Create a new Container configuration sample file and add the `mysql` EZ template to a list of templates that will be installed in Containers created on the basis of this configuration sample file. For example, you can create a new configuration sample with the `mysql` name by running the Create Configuration Sample Wizard in Parallels Management Console and add the `mysql` EZ template to a list of templates on the Select Application Templates step of this wizard.

7 Create Container 101 by using the `vzctl create` command and the `mysql` sample file:

```
# vzctl create 101 --ostemplate redhat-as4-x86 -–config mysql
Creating Container private area (redhat-as4-x86)
Container is mounted
Postcreate action done
Container is unmounted
Container private area was created
Delete port redirection
Adding port redirection to Container(1): 4643 8443
```

So, you have just created Container 101 having the customized `mysql` application installed inside it.

Changing System Time From Container

Normally it is impossible to change the system time from a Container. Otherwise, different Containers could interfere with each other and could even break applications depending on the system time accuracy.

Normally only the Hardware Node system administrator can change the system time. However, if you want to synchronize the time via Network Time Protocol (NTP), you have to run NTP software, which will connect to external NTP servers and update the system time. It is not advisable to run application software on the Hardware Node itself, since flaws in the software can lead to compromising all Containers on the Hardware Node. Thus, if you plan to use NTP, you shall create a special Container for it and configure it to have the `sys_time` capability. The example below illustrates configuring such a Container:

```
# vzctl set 101 --capability sys_time:on --save
Unable to set capability on running Container
Saved parameters for Container 101
```

The output of the above command warns you that `vzctl` cannot apply changes in the capabilities to a running Container. The Container has to be restarted before changes take effect:

```
# vzctl stop 101; vzctl start 101
Stopping Container ...
Container was stopped
Container is unmounted
Starting Container ...
Container is mounted
Adding IP address(es): 192.168.1.101
Hostname for Container set: Container101
Container start in progress...
# ssh root@ct101
root@ct101's password:
Last login: Mon Feb 28 23:25:58 2007 from 10.100.40.18
[root@ct101 root]# date
Mon Feb 28 23:31:57 EST 2007
[root@ct101 root]# date 10291300
Tue Feb 29 13:00:00 EST 2007
[root@ct101 root]# date
Tue Feb 29 13:00:02 EST 2007
[root@ct101 root]# logout
Connection to Container101 closed.
# date
Tue Feb 29 13:01:31 EST 2007
```

The command session above shows the way to change the system time from Container 101. The changes will affect all the Containers and the Hardware Node itself. It is not advisable to have more than one Container with the `sys_time` capability set on.

NTP is described in Internet Standard RFC 1305; more information including client software can be obtained from the NTP web server (http://www.ntp.org).

Setting Up iSCSI Environment in Virtuozzo-Based Systems

iSCSI (Internet Small Computer System Interface) is a TCP/IP-based protocol meant for transmitting data over local area networks (LANs), wide area networks (WANs), or the Internet and providing location-independent data storage and retrieval. The iSCSI protocol is mainly used to interconnect hosts (e.g. database servers) with shared storage systems on SANs (Storage Area Networks). In this connection it aims at achieving the following goals:

- *Storage Consolidation*. Various storage resources from many servers around the network can be moved to one or more central locations (e.g. data centers) on the SAN, which allows you to allocate storage resources more efficiently. For example, any server on the SAN can be allocated a new disk volume without making changes to the server resources. Similarly, any server upgrades or expansions can be performed without impacting the storage resources on the SAN.
- *Disaster Recovery* and *Business Continuity*. The iSCSI protocol can be used to allow for remote data replication and near real time data backup across vast distances providing a cost effective solution to disaster recover and business continuity.

The implementation of an iSCSI storage system in a Virtuozzo Containers environment does not differ from that in standard environments and is based on the three main components: a TCP/IP network, an initiator, and a target. The interaction among the components in a Virtuozzo-based system may roughly be described as follows:

- A Hardware Node acting as an initiator sends a SCSI command (request) over the TCP/IP network to the target represented by a SCSI data storage system (i.e. one or more SCSI storage devices).
- The target processes the received request and takes the appropriate action.

To configure a Hardware Node to communicate with a target (e.g. some SCSI storage device) via the iSCSI protocol, you should perform the following operations on the Node:

1. Install the `iscsi-initiator-utils` RPM package providing the server daemon for the iSCSI protocol and the necessary utilities for its managing:

```
# rpm -ihv iscsi-initiator-utils-6.2.0.742-0.5.el5.i386.rpm
```

2. Discover your iSCSI target using the `iscsiadm` utility:

```
# iscsiadm --mode discovery --type sendtargets --portal <target_IP_address>
```

   where `<target_IP_address>` denotes the IP address used to access the target.

3. Log in to the target using the `iscsiadm` utility:

```
# iscsiadm --mode node --login automatic
```

   This command saves the information about the target to the `/var/lib/iscsi/nodes` directory on the Hardware Node, which allows your Node to automatically detect the iSCSI target on its boot.

After completing the operations above, a new iSCSI device should appear under the `/dev` directory on your Node. You can find out the device name using the `fdisk -l` or `tail -f /var/log/messages` command.

Now you can mount the iSCSI device to your Hardware Node using the `mount` utility. Assuming that your iSCSI device has the name of `/dev/sdb1` and you wish to mount it to the `/vz` directory on your Node, this can be done as follows:

```
# mount /dev/sdb1 /vz
```

Note: If you have not yet partitioned your target, you should partition it and create a filesystem on it (using the `fdisk` and `mkfs` utilities) prior to mounting the iSCSI device to your Node.

You can also automate the procedure of mounting your iSCSI partition on the Hardware Node boot by editing the `/etc/fstab` file. For example, if you wish to have the `/dev/sdb1` partition automatically mounted on the Node boot and this partition is formatted to ext3, you can add the following string to the `/etc/fstab` file:

```
/dev/sdb1 /vz ext3 defaults 0 0
```

Important! If your iSCSI partition is formatted to ext3, make sure that you have this partition mounted to only one Hardware Node at a time; otherwise, the SCSI storage may become corrupted.

Obtaining Hardware Node ID From Inside Container

The default Virtuozzo Containers installation does not allow users inside a Container to obtain any information specific to the Hardware Node the Container is running on. The reason is that no Container shall have knowledge about the corresponding Hardware Node. A Container can be transparently migrated to another Hardware Node, and if this Container runs any applications depending on the particular Node, these applications might fail after the migration.

There are however situations when you have to provide some unique Hardware Node ID to some applications. For example, you might want to license your application per Hardware Node. In this case, after the migration your customer will need to re-apply the license for your application.

Parallels Virtuozzo Containers provides access to the unique Hardware Node ID via the `/proc/vz/hwid` file. The default Virtuozzo Containers installation makes this file accessible to Containers from 1 to 100 (i.e. Containers with Virtuozzo-reserved IDs). It is possible to change this range in the Virtuozzo global configuration file. For example, this is the way to make the file visible in Containers from 1 to 1000:

```
# vi /etc/vz/vz.conf
VZPRIVRANGE=”1 1000”
# vzctl exec 101 cat /proc/vz/hwid
0C3A.14CB.391B.6B69.02C9.4022.3E2F.CAF6
```

The above example illustrates accessing the Hardware Node ID from Container 101.

Mounting /vz Partition via Virtuozzo Script

If you experience problems with mounting or accessing the `/vz` partition (e.g. due to some data corruption) and this interferes with the Hardware Node boot-up procedure, you can prevent the `/vz` partition from being mounted at the Hardware Node startup and have it mounted by a special `/etc/init.d/vz` script only after the Node is up and running.

To start using the `vz` script for mounting the `/vz` partition after the Hardware Node boot, you should complete the following tasks:

1. Open the `/etc/fstab` file on the Hardware Node for editing and set the `noauto` flag for the `/vz` partition. After editing, your `fstab` file may look as follows:

```
LABEL=/         /              ext3 defaults 1 1
LABEL=/vz       /vz            ext3 defaults,noauto 1 2
LABEL=SWAP-sda3 swap           swap defaults 0 0
...
```

2. Make sure that the value of the `VZMOUNTS` parameter in the `/etc/sysconfig/vz` file on the Hardware Node is set to `vz`, as shown below:

```
VZMOUNTS="vz"
```

From this point on, the `vz` script will be used to automatically mount the `/vz` partition after the Hardware Node boot. During its execution, the script will:

- Search the `/etc/fstab` file on the Node for partitions having the `noauto` flag set.

Note: As the `/etc/init.d/vz` script checks the `/etc/fstab` file for all partitions with the `noauto` flag set, you can also have any other partition automatically mounted by this script after the Hardware Node boot rather than at the boot time by setting `noauto` for the corresponding partition in the `/etc/fstab` file and indicating the partition name as the value of the `VZMOUNTS` parameter in the `/etc/vz/vz.conf` file.

- Check if these partitions are mounted. If they are not, it will:
  - run the `fsck` utility to examine the partitions and repair them if there are any errors or data loss (please keep in mind that it may take a rather long run to check and fix a damaged file system);
  - mount the partitions.

If the `/vz` partition has errors that cannot be corrected automatically by the script, you can remotely log in to the Hardware Node and troubleshoot the problem.

Managing Mount Points Inside Container

The previous versions of Virtuozzo Containers (3.0 and earlier) provide you with the ability to remount any part of the Hardware Node file hierarchy and to have it automatically mounted to/unmounted from a particular Container on its startup/shutdown using special system-wide or per-Container mount/umount action scripts. In Virtuozzo Containers 4.0, this can also be done with the help of the `vzctl` utility. Along with defining what part of the Hardware Node file hierarchy is to be automatically mounted inside a Container on its booting, you can also use `vzctl` to configure certain options (or flags) to be applied to the mounted directories. Currently, you can set the following options for mounted Container directories:

- `noexec`. This option does not allow the execution of any binaries in the mounted directory.
- `nodev`. This option does not allow to interpret character or block special devices in the mounted directory.
- `nosuid`. This option does not allow set-user-identifier or set-group-identifier bits to take effect.

You can manage the mounted directories inside Containers (and, as a consequence, the aforementioned directory options) using the `--bindmount_add` option of the `vzctl set` command. For example, you can execute the following command to set the `noexec` flag for the `/tmp` directory inside Container 101, thus forbidding the execution of any binaries in this directory:

Note: You can set mount points for and remove them from stopped Containers only; the mount points will become active/inactive on the Container startup.

```
# vzlist -a
      CTID      NPROC STATUS    IP_ADDR         HOSTNAME
         1         32 running   127.0.1.2       localhost
       101          - stopped   10.12.12.101    -
# vzctl set 101 --bindmount_add /tmp,noexec --save
Saved parameters for Container 101
# vzctl start 101
Starting Container ...
Container is mounted
Set up bind mount(s): /tmp
...
```

To check that the directory has been successfully mounted with the specified option, you can run the following command:

```
# vzctl exec 101 mount
vzfs  on / type vzfs (rw)
simfs on /tmp type simfs (rw,noexec)
proc  on /proc type proc (rw,nodiratime)
```

The directories mounted inside Containers using the `--bindmount_add` option are displayed as the ones of the `simfs` type. So, the command output above shows that the `/tmp` mount point is currently available inside Container 101 and that this mount point has the following flags set for it: `rw` and `noexec`.

If a directory to be remounted does not exist inside a Container, this directory is created under `/vz/private/CT_ID/mnt/Dir_Name` on the Hardware Node (where `Dir_Name` is the name of the directory you wish to mount) and becomes visible from inside the Container under the `/` directory. For example, assuming that there is no `/root/MyTempDir` directory inside Container 101, you can issue the following command to create such a directory inside the Container and mount it with the `noexec` flag:

```
# vzctl set 101 --bindmount_add /root/MyTempDir,noexec --save
Saved parameters for Container 101
# ls -R /vz/private/101/mnt
/vz/private/101/mnt:
media root

/vz/private/101/mnt/root:
MyTempDir
...
# vzctl exec 101 ls /root
MyTempDir
```

While working with mounted directories, please keep in mind the following:

- There are no restrictions on migrating a Container with one or several mount points inside. Having been moved to the Destination Node, the Container will have the same mount points with the same flags (`noexec`, `nodev`, `nosuid`) as it had on the Source Node before the migration.
- The permissions set for the mounted directories are taken from the corresponding upper-level directories (e.g. the permissions for the `MyTempDir` directory inside Container 101 in the example above are derived from the `/root` directory inside the Container).
- If there is no upper-level directory, the directory permissions are set to `0777` meaning that owners, groups, and others have read, write, and search permissions in respect of this directory.
- For mount points quota accounting, standard per-Container quota calculation rules are used since all bind mounts are located in the `/vz/private/CT_ID/mnt` directory on the Hardware Node.

At any time you can remove a mount point from a Container. For example, you can delete the `/tmp` mount point from Container 101 by executing the following command:

```
# vzlist -a
      CTID      NPROC STATUS    IP_ADDR         HOSTNAME
         1         32 running   127.0.1.2       localhost
       101          - stopped   10.12.12.101    -
# vzctl set 101 --bindmount_del /tmp --save
Saved parameters for Container 101
```

Preserving Application Data During Container Reinstallation

A typical Container reinstallation creates a new Container instead of the broken one using the corresponding OS and application templates and mounting the filesystem of the broken Container to the `/tmp` directory inside the new one, which does not let the necessary data from the old Container get lost. However, a manual copying of the broken Container contents to the new Container may prove a tedious and time-consuming task. Beginning with version 3.0.0 SP1, The Virtuozzo Containers software allows to automate this process by performing special scripts that would copy the relevant data to the appropriate places of the new Container after the reinstallation. Naturally, these scripts deal with the data of particular applications only; in fact, this functionality should be supported by application templates that should carry the reinstall scripts specific to them and install them to the `/etc/vz/reinstall.d` directory inside the Container. Only then will Parallels Virtuozzo Containers be able to make use of them, should the Container be reinstalled one day.

Let us consider a typical scenario of such an automation by the example of the Plesk application:

1 The Plesk application template is repackaged to include the necessary reinstall scripts.

Note: Usually it is up to the application vendor or the template maker to provide this kind of scripts. However, if you have a certain experience with making application templates yourself, you may do it on your own. The reinstall script(s) should be first packaged into an RPM, which should in its turn be added to the template.

2 A new Container is created and the Plesk application template is added to it. Part of this addition consists in copying the reinstall scripts to the `/etc/vz/reinstall.d` directory inside the Container.

3 A Plesk license is manually copied to the appropriate place inside the Container and installed.

4 The Container administrator performs typical day-to-day tasks with the help of the Plesk control panel. The local Plesk database gets filled up with all kinds of objects (servers, domains, hostnames, IP addresses, logs, etc.).

5 Some day the Container gets broken and wouldn't start. The Container administrator clicks the **Reinstall** button in Parallels Power Panel. At this point Parallels Virtuozzo Containers:

   a Creates a brand-new Container with the necessary templates added to it. This means that Plesk is also added and the `/etc/vz/reinstall.d` directory with the Plesk scripts is created.

   b Mounts the filesystem of the broken Container to the `/mnt` directory inside the new Container.

   c **NB:** Launches scripts from the `/etc/vz/reinstall.d` directory. These scripts are executed one by one in the alphabetical order. They take care of copying both the Plesk license and the Plesk database to the new Container and installing the license.

   d Dismounts the old filesystem from the `/mnt` directory.

6 The Container administrator gets their working Container again with the Plesk application having retained both its license and database, so no manual copying is involved in the process.

When launching the `vzctl reinstall` command from the command line, you have the option to drop certain scripts from the reinstallation procedure. This can be done with the help of the `--scripts` option:

```
# vzctl reinstall 101 --scripts 'script1 script2'
```

In this example only the scripts named `script1` and `script2` will be launched at the end of the reinstallation, and all the other scripts from the Container `/etc/vz/reinstall.d` directory will be discarded.

Accessing Devices From Inside Container

It is possible to grant a Container read, write, or read/write access to a character or block device. This might be necessary, for example, for Oracle database software if you want to employ its ability to work with raw disk partitions.

In most cases, providing access to the file system hierarchy for a Container is achieved by using bind mounts. However, bind mounts do not allow you to create new partitions, format them with a file system, or mount them inside a Container. If you intend to delegate disk management to a Container administrator, you shall use either the `–-devices` or the `--devnodes` option of the `vzctl set` command.

The example session below illustrates the following situation: you want to allow the root user of Container 101 to take responsibility for administering the `/dev/sdb`, `/dev/sdb1` and `/dev/sdb2` devices. In other words, you allow the Container 101 system administrator to repartition the `/dev/sdb` device and create file systems on the first two partitions (or use them with any software capable of working with raw block devices, such as Oracle database software).

First, we are going to grant the Container the permissions to work with the needed block devices:

```
# vzctl set 101 --devices b:8:16:rw --devices b:8:17:rw --devices
 b:8:18:rw --save
Setting devperms
Saved parameters for Container 101
```

This command sets the read/write permissions for block devices with major number 8 and minor numbers 16, 17 and 18 (corresponding to `/dev/sdb`, `/dev/sdb1`, and `/dev/sdb2`). If you are not sure which major and minor numbers correspond to the necessary block devices, you may issue the following command:

```
# ls -l /dev/sdb{,1,2}
brw-rw----    1 root     disk       8,  16 Jan 30 13:24 /dev/sdb
brw-rw----    1 root     disk       8,  17 Jan 30 13:24 /dev/sdb1
brw-rw----    1 root     disk       8,  18 Jan 30 13:24 /dev/sdb2
```

Now let us create a 100-Mb Linux partition in addition to an already existing 2 GB partition on `/dev/sdb1` from Container 101.

```
[root@ct101 root]# fdisk /dev/sdb

Command (m for help): p

Disk /dev/sdb: 255 heads, 63 sectors, 2231 cylinders
Units = cylinders of 16065 * 512 bytes

   Device Boot    Start       End    Blocks   Id  System
/dev/sdb1   *         1       255   2048256   83  Linux

Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 2
```

```
First cylinder (256-2231, default 256):
Using default value 256
Last cylinder or +size or +sizeM or +sizeK \
(256-2231, default 2231): +100M

Command (m for help): p

Disk /dev/sdb: 255 heads, 63 sectors, 2231 cylinders
Units = cylinders of 16065 * 512 bytes

   Device Boot    Start       End    Blocks   Id  System
/dev/sdb1   *         1       255   2048256   83  Linux
/dev/sdb2           256       268    104422+  83  Linux

Command (m for help): w
```

After the new partition table has been written, you can format it and mount inside the Container:

```
[root@ct101 root]# mke2fs /dev/sdb2
[Output of mke2fs is skipped…]
[root@ct101 root]# mount /dev/sdb2 /mnt
[root@ct101 root]# df
Filesystem           1k-blocks      Used Available Use% Mounted on
vzfs                   1048576    149916    898660  15% /
ext2                    101107        13     95873   1% /mnt
```

Remember that you have to specify all minors for the devices you want to delegate authority for; allowing to access `/dev/sdb` grants the permission to create, modify and delete partitions on it, but explicit permissions shall be given for partitions you allow the Container to work with.

Moving Network Adapter to Container

By default, all the Containers on a Node are connected among themselves and with the Node by means of a virtual network adapter called venet0. Starting with Virtuozzo Containers 2.6.1, there is a possibility for a Container to directly access a physical network adapter (for example, eth1). In this case the adapter becomes inaccessible to the Hardware Node itself. This is done with the help of the vzctl command:

```
# vzctl set 101 --netdev_add eth1 --save
Add network device: eth1
Saved parameters for Container 101
```

Mind that the network device added to a Container in such a way has the following limitations:

- This network device will be accessible only to the Container whereto it has been moved, but not to the Hardware Node (Container 0) and not to all the other Containers on the Node.
- The port redirection mechanism is not supported for this network device.
- The Virtuozzo class-based traffic shaping, if set for the given Container, does not limit the bandwidth for this network device.
- If such a device is removed from the Container (by means of the vzctl set --netdev_del command) and added to another Container instead, all the network settings of this device are purged. To work around this problem, you should store all the device settings in the ifcfg-dev file and have this file available in the /etc/sysconfig/network-scripts directory inside all the Containers that may have access to this device (including Container 0). After the device has been added to a Container, it will be enough to issue the ifup *dev* command inside the Container to read the settings from the file mentioned above. Mind though that this will still not restore advanced network configuration settings, such as traffic shaping or packet filtering rules.
- The physical device inside a Container has no security restrictions typical for the venet virtual device. Inside the Container it will be possible to assign any IP address to this device and use it, to sniff network traffic in the promiscuous mode, and so on.

Enabling VPN for Container

Virtual Private Network (VPN) is a technology which allows you to establish a secure network connection even over an insecure public network. Setting up a VPN for a separate Container is possible via the TUN/TAP device. To allow a particular Container to use this device, the following steps are required:

- Make sure the `tun.o` module is already loaded before Parallels Virtuozzo Containers is started:

```
# lsmod
```

- Allow the Container to use the TUN/TAP device:

```
# vzctl set 101 --devices c:10:200:rw --save
```

- Create the corresponding device inside the Container and set the proper permissions:

```
# vzctl exec 101 mkdir -p /dev/net
# vzctl exec 101 mknod /dev/net/tun c 10 200
# vzctl exec 101 chmod 600 /dev/net/tun
```

Configuring the VPN proper is carried out as a common Linux administration task, which is out of the scope of this guide. Some popular Linux software for setting up a VPN over the TUN/TAP driver includes Virtual TUNnel <`http://vtun.sourceforge.net/`> and OpenVPN <`http://openvpn.sourceforge.net/`>.

Managing Hardware Node Resources Parameters

Virtuozzo Containers 4.0 allows you to configure a number of resource management parameters defining the amount of resources to be allocated to the Hardware Node (also known as Container 0). These parameters include all standard UBC parameters (VMGUARPAGES, KMEMSIZE, OOMGUARPAGES, etc.) as well as the ONBOOT parameter.

You can edit any of these parameters in the /etc/vz/conf/0.conf file on the Hardware Node by means of your favorite text editor (for example, vi or emacs) or by using the vzctl set command and specifying 0 as the Container ID. For example:

```
# vzctl set 0 --kmemsize 12211840:14359296 --save
Saved parameters for Container 0
```

This command sets both the barrier and limit values of unswappable kernel memory (in bytes) which can be allocated to internal kernel structures of the processes on the Node. The specified parameter values will be in force until the Hardware Node restart. If you wish these values to be applied to the Node on its next booting, you should additionally set the ONBOOT parameter in the /etc/vz/conf/0.conf file to yes. This can be done in one of the following ways:

- Passing the --onboot option to the vzctl set command:

```
# vzctl set 0 --onboot yes
Saved parameters for Container 0
```

- Editing the /etc/vz/conf/0.conf file with your favorite text editor (e.g. vi) and setting the value of the ONBOOT parameter in this file to yes.

Note: Detailed information on all resource parameters that can be changed in respect of your Hardware Node is provided in the Parallels Virtuozzo Containers Reference Guide.

If you have made a number of changes to Hardware Node resource management parameters and wish to reset them to the values specified in the /etc/vz/conf/0.conf file, you can proceed as follows:

```
# vzctl set 0 --reset_ub
UBC limits were set successfully
```

Setting Immutable and Append Flags for Container Files and Directories

Starting with Virtuozzo Containers 3.0 SP 1, you can use standard Linux utilities - `chattr` and `lsattr` - to set extra flags for files and directories inside your Containers and to query their status, respectively. Currently, two of these extra flags - 'append' and 'immutable' - are supported. For example, you can execute the following command to set the 'immutable' flag for the `/root/MyFile` file inside Container 101:

```
[root@ct101 root] chattr +i /root/MyFile
```

To check that the 'immutable' flag has been successfully set, use the following command:

```
[root@ct101 root] lsattr /root/MyFile
----i-------- /root/MyFile
```

Note: For detailed information on the `chattr` and `lsattr` utilities, please see their manual pages.

Recreating Service Container

The Service Container should be created on every Node you are going to manage with the help of Parallels Management Console, Infrastructure Manager, or Power Panel.

Note: In general, you are allowed to perform the same operations in the Service Container context as you would perform in the context of a regular Container. However, you are not recommended to change the default configuration of the Service Container (e.g. install your own applications/templates into or store your private files inside this Container). Changing the Service Container configuration may affect all the other Containers residing on the given Hardware Node.

In case your Service Container starts experiencing problems for some reason or other and cannot be used to further manage the Hardware Node(s) and its(their) Containers, you can recreate it using a special utility shipped with Virtuozzo Containers 4.0 - `vzsveinstall`. The `vzsveinstall` utility takes the Service Container IP address and the path to RPM packages from your Virtuozzo Containers distribution as parameters and does all the necessary installation tasks. By default, `vzsveinstall` uses the `redhat-as3-minimal` OS template to create the Service Container; so, you should have this OS template installed on the Hardware Node and cached.

Let us assume that you wish to create the Service Container with the IP address of `10.100.105.1` and the Virtuozzo Containers distribution is located in the `/root/vz_download` directory on your Hardware Node. To make the Service Container, you should execute the following commands:

```
# cd /root/vz_download
# vzsveinstall -f -d virtuozzo/RPMS -c client -s 10.100.105.1
Creating Container private area
[skipping most of the vzsveinstall output…]
```

Customizing /proc/meminfo Output Inside Container

The `/proc/meminfo` virtual file allows you to view the information about memory usage (both physical and swap) on the system. In the current version of Virtuozzo Containers, you can customize the output of this file inside a particular Container and set it to one of the following modes:

- *Non-virtualized*. In this case running the `cat /proc/meminfo` command inside a Container will display the information about the physical memory on the Hardware Node (total, used, free, shared, etc.), in kilobytes.
- *Virtualized in pages*. Setting the `/proc/meminfo` output to this mode allows you to specify what amount of total memory (in kilobytes) will be displayed while running the `cat /proc/meminfo` command inside this or that Container.
- *Virtualized in privvmpages*. Setting the `/proc/meminfo` output to this mode also allows you to arbitrarily specify the amount of total memory (in kilobytes) to be displayed while running the `cat /proc/meminfo` command inside this or that Container. As distinct from the previous mode, the amount of memory to be shown in this mode is calculated on the basis of the value of the `PRIVVMPAGES` parameter set in the Container configuration file.

Notes: 1. Enabling this or that mode for a Container does not exert any influence on the real resources allocation to the Container; it is only used to modify the way the `/proc/meminfo` output will look inside this Container.

2. The output of the `/proc/meminfo` file cannot be customized if the new SLM functionality is enabled on the Hardware Node. In this case the `cat /proc/meminfo` command executed inside a Container always displays the amount of memory set for this Container using the `--slmmemorylimit` option of the `vzctl set` command.

During the Virtuozzo Containers installation, the output of the `/proc/meminfo` virtual file is set to the '*non-virtualized'* mode, i.e. running the `cat /proc/meminfo` command inside any Container on the Hardware Node will show information about the memory usage on this Node. You can use the `--meminfo` option with the `vzctl set` command to switch between different modes:

- To set the output of `/proc/meminfo` inside Container 101 to the '*virtualized in pages*' mode, issue the following command on the Node:

```
# vzctl set 101 --meminfo pages:2000 --save
```

  The amount of memory that will be displayed by running the `cat /proc/meminfo` command inside Container 101 is defined by the data specified after the `--meminfo` option:

  - `pages` tells the `vzctl set` command that you wish to enable the '*virtualized in pages*' mode for the `/proc/meminfo` output and simultaneously denotes the units of measurement to be used for setting the amount of memory (e.g. 4-Kb pages for Containers running 32-bit operating systems);
  - `200` denotes the number of pages to be shown in the `/proc/meminfo` output.

In our case the /proc/meminfo output inside Container 101 may look like the following:

```
# vzctl exec 101 cat /proc/meminfo
MemTotal:           8000 kB
MemFree:            5140 kB
LowTotal:           8000 kB
LowFree:          5140 kB
Buffers:             0 kB
Cached:              0 kB
SwapCached:          0 kB
HighTotal:           0 kB
HighFree:            0 kB
...
```

While working in this mode, please keep in mind the following:

- The specified amount of memory (in our case it is 8000 Kb) is always shown in the MemTotal and LowTotal fields of the cat /proc/meminfo output.
- The values in the MemFree and LowFree fields are calculated automatically by the system.
- All the other fields in the command output have the values set to 0.

- To set the output of /proc/meminfo inside Container 101 to the '*virtualized in privvmpages*' mode, execute the following command on the Node:

```
# vzctl set 101 --meminfo privvmpages:3 --save
```

The amount of memory that will be displayed by running the cat /proc/meminfo command inside Container 101 is calculated using the following formulas:

- *Privvmpages_Value* * 3 * 4Kb if Container 101 is running a 32-bit operating system (OS) or an OS for x86-64 processors and
- *Privvmpages_Value* * 3 * 16Kb if Container 101 is running an OS for IA-64 processors

where *Privvmpages_Value* denotes the value of the PRIVVMPAGES parameter set in the Container configuration file and 3 is an arbitrary integer coefficient which you can modify to increase/decrease the amount of memory in the /proc/meminfo output. Assuming that the privvmpages parameter for Container 101 is set to 10000, your output may look as follows:

```
# vzctl exec 101 cat /proc/meminfo
MemTotal:         120000 kB
MemFree:           78248 kB
LowTotal:         120000 kB
LowFree:          78248 kB
Buffers:               0 kB
Cached:              0 kB
SwapCached:          0 kB
HighTotal:           0 kB
HighFree:            0 kB
...
```

As can be seen from the example above, the displayed records comply with the same rules as the records in the '*virtualized in pages*' mode.

- To revert the output of `/proc/meminfo` to the default mode, execute the following command on the Node:

```
# vzctl set 101 --meminfo none --save
```

Note: If the value specified after the `--meminfo` option exceeds the total amount of memory available on the Hardware Node, the `cat /proc/meminfo` command executed inside a Container will display the information about the total physical memory on the Node.

The `--save` flag in the commands above saves all the parameters to the Container configuration file. If you do not want the applied changes to persist, you can omit the `--save` option and the applied changes will be valid only till the Container shutdown.

Creating Local Repository Mirror for vzup2date

The `vzup2date-mirror` utility allows you to create local mirrors of the Parallels Virtuozzo official repository storing the latest versions of the Virtuozzo Containers software (i.e. newest versions of the Virtuozzo core and utilities) and used by `vzup2date` to keep your current Parallels Virtuozzo Containers installation up-to-date. You can also use this utility to make local mirrors of updated standard and EZ OS and application templates.

When executed, `vzup2date-mirror` completes a number of tasks (connects to the Virtuozzo official repository, downloads the specified Virtuozzo Containers software updates or updated templates to the server where your mirror is located, etc.) resulting in building a local mirror of the Virtuozzo official repository. The created mirror can then be used to update all your Hardware Nodes from one and the same location on your local network. Building your own local repository mirrors results in less Internet bandwidth consumption and more rapid software updates deployments to your Nodes.

The following subsections provide information on how you can create your own local mirrors of the Parallels Virtuozzo official repository using the `vzup2date-mirror` utility.

Virtuozzo Repository Structure

Before starting to create your own local mirror, it is important to you to have a clear idea of the structure of the Parallels Virtuozzo official repository. This knowledge will be of service to you later on while running `vzup2date-mirror` and specifying the part of the Virtuozzo repository for which you wish to create a mirror (i.e. while deciding on what Virtuozzo Containers update release or what Virtuozzo templates are to be downloaded).

The official Virtuozzo repository is organized as a directory tree at the top of which the `/virtuozzo` directory (the root of the tree) is located. The further repository structure may be described as follows:

- Beneath the root is the directory containing the information about the operating system the packages of which are stored in the Parallels Virtuozzo repository. In our case, it is Linux; so, the full name of the directory is `/virtuozzo/linux`. Please note that you are not allowed to access the root of this directory.
- The next underlying directory represents the microprocessor architecture for which the packages stored in the Parallels Virtuozzo repository are meant. Currently, you can make use of the following directories:
  - `i386`: this directory is meant for Virtuozzo RPM packages and templates to be used on 32-bit platforms;
  - `x86_64`: this directory is meant for Virtuozzo RPM packages and templates to be used on x86-64-bit platforms (e.g. on servers with the AMD Opteron and Intel Pentium D processors installed);
  - `ia64`: this directory is meant for Virtuozzo RPM packages and templates to be used on IA-64-bit platforms (i.e. on servers with the Itanium 2 processor installed).

  Each of the aforementioned directories contains a number of files holding the information on all update releases for the corresponding architecture (e.g. `index.xml`) and on particular update releases (e.g. `index_4.0.0.xml` or `update_ids.4.0.0`).
- The next underlying directories are the following:
  - The `eztemplates` directory containing a set of OS and application EZ templates for the corresponding microprocessor architecture. This directory contains two files - `index.xml` and `update_ids` - holding the information on all available EZ template updates.
  - The `templates` subdirectory containing a set of OS and application standard templates for the corresponding microprocessor architecture. This directory contains two files - `index.xml` and `update_ids` - holding the information on all available standard template updates.
  - A directory representing the major Virtuozzo Containers release version for the corresponding microprocessor architecture (e.g. `/virtuozzo/linux/i386/4.0.0` for the Virtuozzo Containers 4.0 release). This directory contains the `index.xml` and `update_ids` files holding the information on all available updates for the given release, a number of additional `xml` files and subdirectories described below.
- A number of subdirectories containing updated packages for particular Parallels Virtuozzo components (e.g. `/virtuozzo/linux/i386/4.0.0/TU-4.0.0-3` keeping updates for your current Virtuozzo utilities).

Creating Local Mirror

The process of creating your local repository mirror which will be locally available to your Hardware Nodes includes the following main stages:

1 Installing the `apache` application on the server where your local mirror will be kept, if it is not yet installed. Currently, you can create HTTP-based mirrors only; so, `apache` is needed to make your server function as a web server.

Note: We recommend that you always store your mirrors inside individual Containers or on dedicated servers not to compromise the Hardware Node security.

2 Installing the `vzup2date-mirror` RPM package shipped with the Virtuozzo Containers 4.0 distribution using the `rpm -i` command.

3 Configuring the `vzup2date-mirror` configuration file that will be used by this utility on the step of connecting to the Parallels Virtuozzo official repository and deciding what updates to download to your local mirror.

4 Running the `vzup2date-mirror` utility on the server where you are going to set up the mirror. This will create a special directory on this server and download all the required packages from the Parallels Virtuozzo official repository to this directory.

5 Telling the `vzup2date` utility to use the local mirror for updating your Virtuozzo Containers software instead of connecting to the Parallels Virtuozzo official repository. To this effect, you should replace the value of the `Server` parameter in the `/etc/sysconfig/vzup2date/vzup2date.conf` file on each Hardware Node where the `vzup2date` utility is to be run with the path to your local mirror.

Let us clear up the aforementioned statements by following the example below. In this example we presume the following:

- You wish to create a local repository mirror that will store system files for the 32-bit version of the Virtuozzo Containers 4.0 release and use it to update all Hardware Nodes in your local network.
- Your mirror will be located in the `/var/www/html` directory inside Container 101.
- Container 101 is started and has the IP address of `192.168.0.101` assigned to it (i.e. it can be accessed from your local network using this IP address).

Note: You can also assign a public IP address to the Container and make it accessible from your Hardware Nodes on other networks.

- The `apache` web server is running inside Container 101 and the default document root for `apache` is `/var/www/html`.

To create a local mirror and make it available to your Hardware Nodes, you should perform the following operations:

1 Log in to Container 101 (e.g. via SSH) and install the `vzup2date-mirror` package there. For example:

```
# rpm -ihv vzup2date-mirror-4.0.0-17.swsoft.noarch.rpm
```

Note: You may need to additionally install a number of Perl packagesto satisfy the `vzup2date-mirror` dependencies. For example, if you are creating a local mirror in a Container based on the `sles-9-x86_64` or `sles-10-x86_64` EZ OS template, you have to install the `perl-Crypt-SSLeay` package before installing the `vzup2date-mirror` package inside this Container.

2 Edit the `vzup2date-mirror.conf` file. It is located in the `/etc/vzup2date-mirror` directory inside Container 101. This file is used by the `vzup2date-mirror` utility to:

- retrieve the path and the credentials to access the Parallels Virtuozzo official repository
- define what packages are to be downloaded to your local mirror
- define the place where the mirror is to be located.

You can edit this file according to your needs or leave the default settings. For example, your `vzup2date-mirror.conf` file may look like the following:

```
Server=http://vzup2date.swsoft.com
User=user1
Password=sample
HTTP_PROXY=http://192.168.1.20
HTTP_PROXY_PASSWORD=wer26sd2
HTTP_PROXY_USER=Peter
LocalRepositoryRoot=/var/www/html
Releases=i386/4.0.0
MirrorName=MyMirror
HTTPD_CONFIG_FILE=/etc/httpd/conf/httpd.conf
```

The aforementioned parameters define the behaviour of the `vzup2date-mirror` utility during the local mirror creation as follows:

- The `Server`, `User` and `Password` parameters are used by the utility when connecting to the Parallels Virtuozzo official repository. As a rule, these parameters are set automatically and do not need to be modified.
- The `HTTP_PROXY` group of parameters should be used if you are connecting to the Internet via a proxy server.
- The `LocalRepositoryRoot` and `MirrorName` parameters define the mirror location and name, respectively.
- The `Releases` parameter determines the list of updates to be downloaded to the local mirror from the Parallels Virtuozzo repository. For more information on how to configure this parameter, please see the Choosing Updates for Downloading section (p. 337).
- The `HTTPD_CONFIG_FILE` parameter defines the functioning of your local mirror as an HTTP-based server providing the path to the `httpd` configuration file. By default, this parameter is set to `/etc/httpd/conf/httpd.conf`. If you have not changed the default `httpd.conf` file location, you do not need to modify this parameter.

Note: Detailed information on all the parameters that can be set in the `vzup2date-mirror` configuration file is provided in the Parallels Virtuozzo Containers Reference Guide.

3 Create a local mirror inside Container 101:

```
# vzup2date-mirror
```

During the command execution, `vzup2date-mirror` will perform the following operations in accordance with the parameters set in the `vzup2date-mirror.conf` file:

- Connect to the Parallels Virtuozzo official repository using the specified URL, credentials, and proxy server settings.
- Create the `/var/www/html/virtuozzo/linux/i386/4.0.0` directory inside Container 101 according to the values of the `LocalRepositoryRoot` and `Releases` parameters and copy all the packages contained in the subdirectories of the `/virtuozzo/linux/i386/4.0.0` directory of the Parallels Virtuozzo official repository to the `/var/www/html/virtuozzo/linux/i386/4.0.0` directory inside Container 101.
- Create a number of files in the `/var/www/html/virtuozzo/linux/i386` directory (e.g. `index.xml` and `index_4.0.0.xml`) containing the information on all major system update releases available for the i386 architecture and on all minor update releases included in the Virtuozzo Containers 4.0 release.

Note: To create a local mirror storing the latest versions of Virtuozzo standard and EZ templates, you should configure the `vzup2date-mirror.conf` file and specify the `-t` or `-z` option when running the `vzup2date-mirror` utility, respectively. Please see the Choosing Updates for Downloading section (p. 337) and the Parallels Virtuozzo Containers Reference Guide for details.

4 Set the value of the `Server` parameter in the `/etc/sysconfig/vzup2date/vzup2date.conf` file on each Hardware Node where the `vzup2date` utility is to be run to `http://192.168.0.101`.

From now on, the `vzup2date` utility will use the created local repository mirror to update all Hardware Nodes in your local network.

At any time, you can run `vzup2date-mirror` to check if there are any updates available to your local mirror. The second and all subsequent times you run the utility, it will download only those packages that are currently absent from your mirrored releases or the MD5SUM check sum of which differs from that of the packages in the mirrored releases and will put them to the corresponding directories. As for the aforementioned example, all changed packages for the 4.0 major release will be downloaded to the `/var/www/html/virtuozzo/linux/i386/4.0.0` directory inside Container 101.

Choosing Updates for Downloading

When executed without any options, the `vzup2date-mirror` utility downloads all the available system updates for all architectures and releases to your local mirror. If you wish to download all available EZ or standard templates updates, you should additionally pass the `-z` or `-t` option to `vzup2date-mirror`, respectively. You can also make the utility download particular system and templates updates only. This can be done by editing the `Releases` parameter in the `vzup2date-mirror.conf` file. Let us assume that you wish to get the following updates from the Parallels Virtuozzo official repository:

- all system updates for the 32-bit version of Virtuozzo Containers 4.0;
- all updates for the `centos-4` and `fedora-core-8` EZ templates intended for use on the 64-bit version of Virtuozzo Containers for x86-64-bit processors;
- all updates for the `centos4` standard template intended for use on the 32-bit version of Virtuozzo Containers.

To make the `vzup2date-mirror` utility download only the aforementioned updates to your local mirror, you should first create three separate configuration files for `vzup2date-mirror` - one file per each update type (system, EZ template, and standard template). The necessity of creating three separate files is caused by the fact that the format of the `Releases` parameter for system, EZ templates, and standard templates updates is different:

- For system updates, the `Releases` parameter should be set in the *`arch`*/*`Virtuozzo_release`* format where *`arch`* and *`Virtuozzo_release`* denote the microprocessor architecture and the major Virtuozzo Containers release version, respectively, for which the updates are to be downloaded (e.g. `x86_64/4.0.0`).
- For EZ templates updates, the `Releases` parameter should be set in the *`arch`*/*`EZ_template_name`* format where *`arch`* and *`EZ_template_name`* denote the microprocessor architecture and the name of the EZ template, respectively, for which the updates are to be downloaded (e.g. `x86_64/fedora-core-8`).
- For standard template updates, the `Releases` parameter should be set in the *`arch`*/*`standard_template_name`* format where *`arch`* and *`standard_template_name`* denote the microprocessor architecture and the name of the standard template, respectively, for which the updates are to be downloaded (e.g. `i386/centos4`).

The easiest way to make three configuration files is to use the default `/etc/vzup2date-mirror/vzup2date-mirror.conf` file for system updates and create two copies of this file for EZ and standard templates updates. Let us name these files `vzup2date-mirror-z.conf` (this file will be responsible for handling EZ templates updates) and `vzup2date-mirror-t.conf` (this file will be responsible for handling standard templates updates) and put them to the `/etc/vzup2date-mirror` directory.

After creating three separate configuration files, you should configure the `Releases` parameter in each file to tell the `vzup2date-mirror` utility to download certain system and templates updates only:

- Configure the `Releases` parameter in the `vzup2date-mirror.conf` file by setting its value to `i386/4.0.0`:

```
# vi /etc/vzup2date-mirror/vzup2date-mirror.conf
Releases=i386/4.0.0
```

- Configure the `Releases` parameter in the `vzup2date-mirror-z.conf` file by setting its value to `x86_64/centos-4, x86_64/fedora-core-8`:

```
# vi /etc/vzup2date-mirror/vzup2date-mirror-z.conf
Releases=x86_64/centos-4, x86_64/fedora-core-8
```

- Configure the `Releases` parameter in the `vzup2date-mirror-z.conf` file by setting its value to `i386/centos4`:

```
# vi /etc/vzup2date-mirror/vzup2date-mirror-t.conf
Releases=i386/centos4
```

Now you can start downloading the specified updates. To this effect, run the following commands on the server where your local mirror resides:

To download all system updates for the 32-bit version of Parallels Virtuozzo 4.0:

```
# vzup2date-mirror
```

To download all updates for the `centos-4` and `fedora-core-8` EZ templates intended for use on the 64-bit version of Parallels Virtuozzo for x86-64-bit processors:

```
# vzup2date-mirror -z -c /etc/vzup2date-mirror/vzup2date-mirror-z.conf
```

To download all updates for the `centos4` standard template intended for use on the 32-bit version of Parallels Virtuozzo 4.0:

```
# vzup2date-mirror -t -c /etc/vzup2date-mirror/vzup2date-mirror-t.conf
```

The `-c` option in the last two commands tells the `vzup2date-mirror` utility to use the necessary parameters from the specified configuration files instead of the default one.

Configuring Updates Approval Policy

The `vzup2date-mirror` updates approval mechanism enables you to define the updates approval policy for deploying Virtuozzo Containers system updates to the Hardware Nodes in your local network. By default, all updates downloaded to your local mirror are automatically approved for installation on your Nodes. However, you can change the default policy and postpone the updates distribution to your Nodes until these updates are thoroughly tested by your IT department against the compatibility with your working environments. Let us assume the following:

- All Hardware Nodes in your local network are running the x86-64-bit version of Windows Server 2003 and have the following software installed:
  - the `4.0` version of Parallels Virtuozzo Containers;
  - the `2.6.9-023stab041.3` version of the Virtuozzo kernel;
  - the `4.0.0-200` version of the Virtuozzo tools and command-line utilities.

- All Hardware Nodes are configured to get system and templates updates from a mirror in your local network.
- You wish to forbid your Hardware Nodes to obtain Virtuozzo kernel, tools, and command-line utilities updates higher than the versions currently installed on them from your local mirror (e.g. until they are checked on your test server).

To make major versions of the Virtuozzo Containers software higher than `4.0`, Virtuozzo kernel updates higher than version `2.6.9-023stab041.3`, and Virtuozzo tools and utilities updates higher than version `4.0.0-200` invisible for the `vzup2date` utility that you will launch on the Hardware Nodes configured to get updates from your local mirror, you should add the following section to the `vzup2date-mirror` configuration file:

```
<ApproveSystemUpdate x86_64/4.0.0>
    MU=no
    CU=2.6.9-023stab041.3
    TU=4.0.0-200
</ApproveSystemUpdate>
```

This section is opened with the `<ApproveSystemUpdate x86_64/4.0.0>` tag denoting the system architecture (`x86_64`) and the Virtuozzo Containers release (`4.0.0`) the specified policy will be applied to. If you wish to set the updates approval policy for all architectures at once, you should specify `all` instead of `x86_64`. The value of the `MU` parameter set to `no` signifies that no major updates are allowed for downloading to your Nodes. The `CU` and `TU` parameters denote the maximal versions of the Virtuozzo kernel and Virtuozzo tools and utilities that can be downloaded by the `vzup2date` utility to your Hardware Nodes.

Note: Detailed information on all parameters that can be specified in the `vzup2date-mirrow` configuration file, including `ApproveSystemUpdate`, is provided in the vzup2date-mirror Configuration File section of the Parallels Virtuozzo Containers Reference Guide.

Now let us assume that you have downloaded the `2.6.9-023stab041.4` version of the Virtuozzo kernel and the `4.0.0-201` version of the Virtuozzo tools and utilities to your local mirror, have tested them on your test server, and wish to make these updates available to the Hardware Nodes in your network. To this effect, you should configure the `ApproveSystemUpdate` section in the `vzup2date-mirror` configuration file as follows:

```
<ApproveSystemUpdate x86_64/4.0.0>
    MU=no
    CU=2.6.9-023stab041.4
    TU=4.0.0-201
</ApproveSystemUpdate>
```

Loading iptables Modules

The given section provides information on how you can manage `iptables` modules on the Hardware Node and inside particular Containers.

Loading iptables Modules to Hardware Node

You can configure a list of `iptables` modules that will be loaded on the Hardware Node after its startup as follows:

- By using standard means of your Host operating system:
  - On RHEL-based Nodes, by editing the `/etc/sysconfig/iptables-config` file with your favorite text editor (e.g. `vi`) and configuring the value of the `IPTABLES_MODULES` parameter in this file.
  - On SUSE-based Nodes, by editing the `/etc/sysconfig/SuSEfirewall2` file (e.g. by means of the YaST2 configuration tool).

  For example, if your Hardware Node is running Red Hat Linux Enterprise 5, you can make the `ip_conntrack_netbios_ns`, `ip_conntrack`, and `ip_conntrack_ftp` modules load on the Node startup by modifying the `IPTABLES_MODULES` parameter in the `/etc/sysconfig/iptables-config` file as follows:

```
IPTABLES_MODULES="ip_conntrack_netbios_ns ip_conntrack ip_conntrack_ftp"
```

- By editing the `/etc/vz/vz.conf` file on the Hardware Node. The `IPTABLES` parameter in this file determines the `iptables` modules that will additionally be loaded to the Node during the Virtuozzo service startup. For example, you can indicate the following `iptables` modules as the value of this parameter to have them automatically loaded to your Hardware Node after the Virtuozzo service startup:

```
IPTABLES="ipt_REJECT ipt_tos ipt_limit ipt_multiport iptable_filter
          iptable_mangle ipt_TCPMSS    ipt_tcpmss ipt_ttl ipt_length"
```

All the specified modules will be loaded on the Node startup after you reboot the Hardware Node.

Loading iptables Modules to Particular Containers

The list of iptables modules that are loaded to a Container by default is determined by the iptables modules loaded on the Hardware Node at the moment of the Container startup. For example, if your Hardware Node has the ipt_REJECT, ipt_tos, ipt_limit, ipt_multiport, and iptable_filter modules loaded, any Containers on this Node will also have these iptables modules loaded after their startup.

However, Parallels Virtuozzo Containers allows you to prevent certain modules from being loaded inside a Container on its startup, even if they are loaded on the Node itself. The full list of such iptables modules is listed below:

- ip_table;
- ip6_table;
- iptable_filter;
- ip6table_filter;
- iptable_mangle;
- ip6table_mangle;
- ip_conntrack;
- ip_conntrack_ftp;
- ip_conntrack_irc;
- iptable_nat;
- ip_nat_ftp;
- ip_nat_irc.

To forbid the usage of any of the aforementioned iptables modules inside a Container, you should explicitly indicate the names of the modules you wish to be loaded to the Container as the value of the IPTABLES parameter in the Container configuration file (/etc/vz/conf/*<CT_ID>*.conf) or by using the vzctl command. For example:

```
# vzctl set 101 --iptables ip_table --iptables iptable_filter --iptables
ip_conntrack --iptables iptable_nat --iptables iptable_mangle --save
```

This command will tell Virtuozzo Containers 4.0 to:

- load the ip_table, iptable_filter, ip_conntrack, iptable_nat, and iptable_mangle modules to Container 101 if they are loaded on the Hardware Node during the Container startup;
- forbid the usage of all the other iptables modules listed above (i.e. ip6_table, ip6table_filter, ip6table_mangle, ip_conntrack_ftp, ip_conntrack_irc, ip_nat_ftp, ip_nat_irc) inside Container 101 even if they are loaded on the Hardware Node during the Container startup.

This information will also be saved in the Container configuration file thanks to the --save option.

Loading a new set of iptables modules does not happen on the fly. You should restart the Container for the changes to take effect.

Sharing File System Among Containers

This section provides a simple example of what can be done with the help of Container action scripts. You need a basic BASH shell language knowledge to understand the examples.

Remember that when you source configuration files in your action script, you have two environment variables that show the path to Container file areas: `$VE_ROOT` and `$VE_PRIVATE`. You need to use `$VE_ROOT` since the VZFS file system does not follow mount points in the Container private area. In other words, if you mount a directory to the Container private area, the users inside the Container will not see this mount and you should use `$VE_ROOT` in your scripts.

This example shows how to create a configuration when two environments can share files and the necessary setup is automatically created at Containers startup. Let us assume that both environments want to have their user home directories in sync. For the sake of simplicity, let Container 102 (called `test2`) hold actual user directories and Container 101 (called `test1`) use them as well.

In this case, Container 102 does not need any action scripts. All the necessary setup is done by the `mount` script of Container 101. It can look like the following:

```
#!/bin/bash
#
# 101.mount - script to mount home dir of Container 102
# if one of these files does not exist then something is
# really broken
[ -f /etc/sysconfig/vz ] || exit 1
[ -f $VE_CONFFILE ] || exit 1
[ -f /etc/sysconfig/vz-scripts/$veid.conf ] || exit 1

# source these files. Note the order, it is important
. /etc/sysconfig/vz
. $VE_CONFFILE

# If home dirs are not mounted we exit with error
mount --bind /vz/root/102/home $VE_ROOT/home
exit $?
```

This script is intentionally simplified to focus on the main idea of mounting one Container directories inside another. However, it can be developed further by adding checkups for the Container 102 mount status (it is possible to call `vzctl` from the mount script, but do not call `vzctl` with the same Container ID as the Container the mount script is being executed for). It can source the Container 102 configuration file to determine correctly the `VE_ROOT` directory of Container 102.

In order to be able to stop Container 101, you have to create the `umount` script dismounting `$VE_ROOT/home`:

```
#!/bin/bash
#
# 101.umount – a script to umount home directory of Container 102
```

```
# If one of these files does not exist then something is
# really broken
[ -f /etc/sysconfig/vz ] || exit 1
[ -f $VE_CONFFILE ] || exit 1

# Source configuration files to access $VE_ROOT
. /etc/sysconfig/vz
. $VE_CONFFILE

# Dismount shared directory
umount $VE_ROOT/home
```

After starting Container 102 and 101, Containers will have a common `/home` directory.

It is possible to use the same technique for mounting the Hardware Node file system sub tree into a Container, to mount a block device into a Container (for example, a hard drive partition or a CD-ROM), and so on.

Creating Configuration File for New Linux Distribution

Distribution configuration files are used to distinguish among Containers running different Linux versions and to determine what scripts should be executed when performing the relevant Container-related operations (e.g. assigning a new IP address to the Container). Detailed information on distributions configurations files is provided in the **Linux Distribution Configuration Files** subsection of the **Parallels Virtuozzo Containers Reference Guide**.

All Linux distributions shipped with Parallels Virtuozzo Containers have their own configuration files located in the `/etc/vz/conf/dists` directory on the Hardware Node. However, you may wish to create your own distribution configuration files to support new Linux versions released. Let us assume that you wish your Container(s) to run the CentOS 5 Linux distribution and, therefore, have to make the `centos-5.conf` distribution configuration file to define what scripts are to be executed while performing major tasks with Containers running this Linux version. To this effect, you should do the following:

1 In the Container configuration file (with the name of `/etc/vz/conf/`*`CT_ID`*`.conf`), specify `centos-5` as the value of the `DISTRIBUTION` variable (for example, `DISTRIBUTION="centos-5"`).

2 Create the `centos-5.conf` configuration file in the `/etc/vz/conf/dists` directory. The easiest way to do it is copy one of the existing configuration files by executing the following command in the `/etc/vz/conf/dists` directory:

```
# cp fedora.conf centos-5.config
```

In the example above, we assume that the `fedora.conf` file is present in the `/etc/vz/conf/dists` directory on the Hardware Node. In case it is not, you may use any other distribution configuration file available on your Node.

3 Open the `centos.conf` file for editing with the help of any text editor:

```
# vi centos-5.conf
```

4 In the `centos-5.conf` file, go to the first entry and, in the right part of the entry, specify the name of the script you wish to be run on issuing the `vzctl` command with the parameter specified in the left part of the entry. For example, if you wish the script to be executed while assigning a new IP address to your Container and the script has the `my_centos_script` name, your entry should look as follows:

```
ADD_IP=my_centos_script-add_ip.sh
```

Note: The information on all acceptable parameters and their description are provided in the Linux Distribution Configuration Files subsection of the Parallels Virtuozzo Containers Reference Guide.

5 Repeat Step 4 for all entries in the file.

6 Place the scripts for the new Linux distribution to the `/etc/vz/conf/dists/scripts` directory on the Node. Make sure the names of these scripts coincide with those specified in the `centos-5.conf` file.

Rebooting Container

When you issue the `reboot` command at your Linux box console, the command makes the reboot system call with argument '`restart`', which is passed to the server BIOS. The Linux kernel then reboots the server. For obvious reasons this system call is blocked inside Containers: no Container can access BIOS directly; otherwise, a reboot inside a Container would reboot the whole Hardware Node. That is why the `reboot` command inside a Container actually works in a different way. On executing the `reboot` command inside a Container, the Container is stopped and then started by Parallels Agent, which handles this situation.

If you want a Container to be unable to initiate reboot itself, add the `ALLOWREBOOT="no"` line to the Container configuration file (`/etc/vz/conf/`*`CT_ID`*`.conf`). If you want to have Container reboot disabled by default and want to specify explicitly which Containers are allowed to reboot, add the `ALLOWREBOOT="no"` line to the Virtuozzo global configuration file (`/etc/vz/vz.conf`) and explicitly specify `ALLOWREBOOT="yes"` in the corresponding Container configuration files.

If the Parallels Agent software is not running on your Hardware Node for this or that reason, an auxiliary way to allow Containers to reboot themselves is to uncomment the following line in the `/etc/cron.d/vereboot` file:

```
# vi /etc/cron.d/vereboot
[beginning of file]
#* * * * * root /etc/vz/conf/vereboot
```

You can use any editor of your choice instead of the `vi` command. Remove the hash mark on the last line to read:

```
* * * * * root /etc/vz/conf/vereboot
```

Now you can issue the `reboot` command in a Container, and the latter will be started on the next `vereboot` run.

Managing Graphical Applications Inside Container

The given section provides information on how you can run X applications inside your Containers located somewhere on a TCP/IP network and display them on your local server, exploit window managers to customize the appearance of running X applications, and use the `vnc` desktop software to remotely launch graphical applications.

Running Graphical Applications in X Windows

Overview

You may wish to run X applications (X clients) such as `xclock`, `xmms`, etc. inside your Containers on a TCP/IP network and display the resulting output on your local server. This can be done with the help of the X Window System. The X Window System is based on the client/server model where an X server is the program responsible for controlling the display of the server on which you are working and an X client denotes an application program that communicates with the server, sending it various requests, such as "draw a line" or "pay attention to keyboard input".

To run X applications inside your Container located on a TCP/IP network and to display them on your local server, you should take care of the following:

- Install and configure a special software called an X server on the server where you wish X clients to be displayed.

Note: In the following subsections, we assume that you have successfully installed and configured an X server on your local server. In case you have not, please download the X server software packages (e.g. from http://www.xfree86.org) and install them by following the instructions shipped with this software.

- Configure X clients (X applications) to direct their output to your local server where the X server is running.
- You may also wish to specify a window manager of your choice to be used for displaying your X clients.

A central concept of the X Window System is the display, an abstraction for the screen managed by an X server. When an X client is invoked, it needs to know which display to use. Displays are named by strings in the form of *hostname*:*displaynumber*.*screennumber* and should be set as the `DISPLAY` environment variable on the server where X clients are to be run (in our case inside the corresponding Container):

- *hostname* specifies the hostname or the IP address of the machine to which the display is physically connected, i.e. the server where the X server is running (e.g. `198.112.45.11:0.0`). An omitted hostname (e.g. `DISPLAY=:0.0`) would mean the local host.
- `displaynumber` is usually used to refer to a collection of monitors that share a common keyboard and pointer (mouse, tablet, etc.). Most workstations tend to have only one keyboard and pointer, and therefore, only one display. In case a workstation has several displays (i.e. several keyboards or pointer sets), each display on this server is assigned a display number (beginning at 0) when the X server for that display is started. The display number must always be given in a display name.
- `screennumber`. Some displays share a single keyboard and pointer among two or more monitors. Since each monitor has its own set of windows, it is assigned a screen number (beginning at 0) when the X server for that display is started. If the screen number is not given, screen 0 will be used.

For example, if your local server is known to the outside world as `my_local_computer` and located in the `my-domain.org` domain and you are running a normal X server on this server, the value of the `DISPLAY` variable in the Container environment where you wish to remotely run X clients should be set to `my_local_computer.my-domain.org:0.0`.

Using X Windows to Run Graphical Applications

The X Window System lets you start any X application inside any Container on a TCP/IP network and have it show up on your local server where an X server is installed. To run remote X applications, you should first of all tell the X applications running inside your Container to direct their output to the display of your local server. You can do it by specifying the `DISPLAY` environment variable inside the Container. For example, to run the `xfig` drawing program inside your Container and display its output on your local server with the IP address of `199.199.199.199`, you should issue the following commands inside the Container:

```
# DISPLAY=199.199.199.199:0
# export DISPLAY
# xfig &
```

Along with setting the `DISPLAY` environment variable inside your Container, you should also open permissions to your X server so that X applications are allowed to use your local display. You can do it in one of the following ways:

- By using the host list mechanism (`xhost`). In this case the X server maintains a list of hosts which are allowed to connect to it.
- By using the magic cookie mechanism (`xauth`). In this case the X server allows access from any host having an authorization record (a magic cookie) stored inside the server.
- By forwarding X connections via `ssh`.

You can choose any of these ways to remotely run your X applications. However, by using the `xhost` and `xauth` mechanisms, authority records needed to establish a connection between an X server and X application are transmitted over the network with no encryption, whereas using `ssh` enables you to run X applications over encrypted connections. So, if you are worried that someone might snoop on your connections, you can use the X forwarding mechanism, as is shown in the example below.

Let us assume that you wish to run the `xclock` application inside Container 101 and display its output on your local server with the name of `my_local_computer.my-domain.org`. To this effect, you should perform the following operations:

Note: Before running X applications inside a Container on a public network, check that this Container is accessible from your local server where the X server is to be run.

1 On the local server, execute the `startx` command:

```
# /usr/X11R6/bin/startx
```

This starts an X server with a basic terminal window (the default `xterm` application) on your server.

2 Once `xterm` is open, you should establish an `ssh` connection to a Container where you wish to run the `xclock` application:

```
# ssh CT_IP_Address
```

where *`CT_IP_Address`* denotes the IP address or hostname of the Container where your X client is to be run. As has been mentioned above, an `ssh` connection is used to provide security and stronger authentication for an X protocol connection between the X server and the X client by tunneling the X protocol, which is called X forwarding. Moreover, X forwarding automatically sets the `DISPLAY` variable inside the Container to point to your local server and directs the output of X clients running inside the Container to the X server on the local server. X forwarding is enabled in `ssh1` and `ssh2` by default; however, you may additionally use the `-X` option to enable X forwarding in case you are not sure that it is on.

3 After executing the command, you will be prompted for the password to log in to the Container. Provide the `root` user name and their password to log in to the Container and press **Enter**.

4 Now that you have successfully logged in to the Container, execute the `echo $DISPLAY` command to check the value of the `DISPLAY` variable in your Container environment. It should read: `my_remote_computer.swsoft.com:10.0`. As distinct from the `xhost` and `xauth` mechanisms where the display number in the `DISPLAY` variable reflects a real number of displays connected to a server (beginning at 0), `ssh` always uses the 10th display number - a special X display created by `ssh` itself - to pass X protocol information to your local server.

If you do not see any value when typing this command or the value is incorrect, set the `DISPLAY` variable in your Container environment as follows:

```
# DISPLAY=my_remote_computer.swsoft.com:10.0
# export DISPLAY
```

5 Launch the `xclock` application displaying the current time in an analog form by issuing the following command:

```
# xclock
```

If a clock is shown on the screen of your remote server, you have successfully run the `xclock` application.

Note: While running the commands in our example, we assume that you work in the `bash` shell. While working in other Linux shells, you may need to use different commands to start your X server or to set the `DISPLAY` variable on your local server.

Defining Window Manager to Run X Applications

The layout of windows on the screen in the X Window system is controlled by special programs called window managers. Window managers (like `twm`, `wmaker`, `fvwm2`, etc.) are programs that sit between an X server and normal X clients and control the way the running X clients are positioned, resized, or moved on your screen. Although a window manager decides to a great extent how X clients look and feel, it does not affect what client applications do within the window defined by this window manager.

The main operations that can be performed by means of window managers are the following:

- Start and terminate X clients;
- Move, resize, and rearrange the "vertical" stacking of windows;
- Refresh the screen(s);
- Determine which window is to receive input from your keyboard or mouse;
- Create and customize pop-up menus to complete any of the aforementioned tasks, etc.

You can change the default window manager used to control the appearance of your X clients by editing the `Xclients` and `xinitrc` scripts located in the `/usr/X11R6/lib/X11/xinit/` directory either inside your Container or on your local server. However, you can launch only one window manager at any time. So, if you are already running a local window manager, you cannot start the remote one (i.e. it will complain and exit).

Let us assume that you wish to run several X applications (`xterm`, `oclock`, `emacs`) inside your Container and to use the remote `fvwm2` window manager to manage their output on the screen. To this effect, you can edit the `/usr/X11R6/lib/X11/xinit/Xclients` script inside your Container in the following way:

Note: We assume that you have successfully installed the `fvwm2` window manager inside your Container. In case you have not, please download the needed software packages (e.g. from http://www.fvwm.org) and install them by following the instructions shipped with this software.

1 Log in to your Container and open the `/usr/X11R6/lib/X11/xinit/Xclients` file for editing:

```
vi /usr/X11R6/lib/X11/xinit/Xclients
```

This file is just a shell script containing commands that you wish to run when your X session starts (e.g. `xterm`, `xclock`).

2 Remove the existing text in the file and add the following strings to it:

Note: We recommend that you make a copy of the `Xclients` file in case something goes wrong.

```
#!/bin/sh
oclock -geometry 75x75-1-1 &
xterm -C -geometry 80x12+0+0 &
emacs &
fvwm2
```

The clients will be launched in the order in which they are listed in the file; the last line should specify the window manager where the started X clients will run.

3 Save the file.

In our example, the `Xclients` file starts three applications - `xterm`, `oclock`, and `emacs` - and the `fvwm2` window manager where these application are to be run. The `-geometry` options used in the example specify the size and shape of the window. `80x12+0+0` means a window that is 80 characters wide and 12 lines high, positioned at the upper left. The `+` and `-` numbers give the location of the window. The first number gives the X coordinate and the second one gives the Y coordinate. The `+` numbers start from the upper left of the screen; the `-` numbers start from the lower right of the screen. So, `+0+0` means to put the `xterm` application at the upper left corner. Numbers greater than `0` are used to put things in the middle of the screen as in case with the `oclock` window (a round clock) in our example.

Running Graphical Applications via VNC

You may also wish to use VNC (Virtual Network Computing) to remotely run graphical applications inside your Container and display them on your local server. The main features of VNC are the following:

- The server and the client may be on different computer and on different types of computers. The protocol which connects the server and the viewer is simple, open, and platform independent.
- No state is stored at the viewer. Breaking the viewer's connection to the server and then reconnecting will not result in any loss of data. Because the connection can be remade from somewhere else, you have easy mobility.
- The VNC protocol is designed to adapt to the amount of bandwidth available which makes it ideal for thin client deployments.

To start using VNC, you should perform the following operations:

- Install a virtual X server - `vnc` - inside your Container. The `vnc` servers are not associated with a physical display, but provide a "fake" one X clients (`xterm`, `mozilla`, etc.) can attach to.
- Install a `vnc` client - `vncviewer` - on your local server to connect to the `vnc` server from anywhere on the network.
- Connect to the `vnc` server with the `vnc` viewer.

Let us run the `xclock` application inside Container 101 with the hostname of `Container101.com` located on a TCP/IP network and display it on your local server by using VNC.To this effect, you should do the following:

Note: We assume that you have successfully installed a `vnc` server inside your Container and a `vnc` client on your local server. If you have not, please download the needed software packages (e.g. from http://www.realvnc.com) and install them by following the instructions shipped with this software or available on the web site.

1 Log in to Container 101 and start your `vnc` server by issuing the following command:

```
# vncserver
```

If you have never run a `vnc` server before, you will be prompted for a password, which you will need to use when connecting to this server. All the `vnc` servers on your remote server will use the same password; you can change it at a later time by using the `vncpasswd` command. Type the password you consider suitable and press **Enter**.

2 Execute the `echo $DISPLAY` command to check what display number will be used by the `vnc` server to run graphical applications. As you have learnt in the previous subsections, the main X display of a workstation is usually indicated as `0` (in our case it will read `:0`; the hostname is omitted because the `vnc` server is running inside the Container itself). When you run a `vnc` server inside your Container, it will appear as `:1`, as if it were just an additional display. Normally, the `vnc` servers will choose the first available display number and tell you what it is. However, you can specify your own display number (for example, `2`) by typing the following:

```
# vncserver :2
```

You can also cause graphical applications to use a `vnc` server rather than the normal X display by setting the `DISPLAY` variable in the Container environment to the `vnc` server you want (in the examples below, we assume that the display number for the `vnc` server is set to `2`):

```
# export DISPLAY=CT101:2
```

or by starting a graphical application with the `-display` option:

```
# xterm -display CT101:2 &
```

3 Now you should connect the `vnc` viewer running on your local server to the `vnc` server. You can do it by executing the following command on your local server:

```
# vncviewer CT101.com:2
```

where `CT101.com` is the hostname of Container 101 where the `vnc` server is running and `1` denotes the number of the display used by the `vnc` server to run graphical applications.

Note: While using hostnames for connecting to a Container, make sure that your Container has a valid DNS entry. Otherwise, you should replace its hostname with the corresponding IP address.

You can control the way graphical applications are positioned, resized, or moved on the screen of your local server by specifying different options for the `vncserver` command, as you do it by using window managers while running X applications. For example, you can pass the `-geometry` option to `vncserver` to set the size of the desktop to be created (by default, it is 1024x768). You can get a list of all options for the `vncserver` command by giving `-h` as its option.

VZFS v2

VZFS is an integral part of the virtualization technology developed by Parallels, Inc. It translates to Virtuozzo file system and comprises such product as Parallels Virtuozzo Containers for Linux. VZFS allows to share common files among multiple Containers (Containers) without sacrificing flexibility. This sharing saves up to tens of megabytes of RAM and hundreds of megabytes of disk space for each Container. On the other hand, it remains possible for Container users to modify, update, replace, and delete shared files. When a user modifies a shared file, VZFS creates a private copy of the file transparently for the user. Thus, the modifications do not affect the other users of the file. As an additional advantage, VZFS does not require having different physical partitions for different Containers or creating a special “file system in a file” setup for a Container, which significantly simplifies disk administration.

Virtuozzo Containers 4.0 for Linux comes with a new version of VZFS - Version 2. This paper is destined for Virtuozzo administrators who would like to know more of VZFS v2 and to understand the upgrade path for existing Virtuozzo Containers installations.

Advantages of VZFS v2

Main benefits of VZFS v2 in relation to previous VZFS versions are the following:

- The process of creating a Container takes much less time with VZFS v2.
- A Container created from scratch on the basis of an OS EZ template has much fewer files if VZFS v2 is used, because it is not necessary any more to provide each and every file from the template area with a corresponding 'magic' link in the Container private area.
- The disk space occupied by any Container based on EZ templates is greatly reduced.
- Full compatibility with third-party backup tools is provided. For example, an Parallels-specific modification of the common `tar` utility in order to be able to back up a Container is no more necessary.
- The process of backing up and restoring Containers has speeded up significantly.
- Container backups occupy much less disk space than was the case with VZFS v2.
- The migration of Containers using VZFS v2 is performed much quicker.

Inside VZFS v2

By its nature, VZFS is closely related to two other Virtuozzo notions, namely, templates and Container private areas. Templates make use of VZFS to offer themselves for sharing among Containers, and Container private areas obtain the possibility to create links to templates instead of regular files to save RAM and disk space. In this respect VZFS v2 has the following specifics:

- The nature of private area links to templates is altogether different in VZFS v2. These were called 'magic' links in the previous version of VZFS and lacked many characteristics of regular files from the point of view of the Hardware Node filesystem (though they were seen as regular files from inside the corresponding Container). In VZFS v2 these links *are* regular files even when seen from the Hardware Node context. To indicate that these files in fact point to template files, they are named *shortcuts* in Virtuozzo Containers 4.0 as distinct from 'magic' links in VZFS v1 and Virtuozzo Containers 3.0.
- Whereas in the previous version of VZFS each and every file from a template had to be represented by its own 'magic' link in a Container private area, in VZFS v2 a single shortcut suffices for a whole directory inside a template together with all its subdirectories, files, and symlinks. This shortcut contains all the information on the structure of a directory from the template area. If a Container user modifies a shared file inside their Container, VZFS v2 just creates a private copy of this file inside the Container private area. On the other hand, if a Container user modifies the structure of a shared directory by adding, deleting, or renaming some file(s) in it, VZFS v2 replaces the shortcut representing this directory with a number of shortcuts each representing a single subdirectory, file, or symlink from the template area. A single shortcut is no more sufficient because the structure of the directory inside the Container private area has come to be different from that inside the template area.
- In VZFS v2, symlinks are included in a template in the same way as regular files and directories. In the previous version of VZFS, only regular files and directories were installed in a template area and thus represented by their 'magic' links in Container private areas, whereas symlinks were simply copied to the private areas. VZFS v2 extends the copy-on-write (COW) mechanism on symlinks, as well.
- EZ templates based on VZFS v2 are backwardly compatible with private areas based on VZFS v1, though in this case VZFS v2 advantages are not available before the conversion of the private areas to VZFS v2 is performed.
- VZFS v2 is not applicable to standard Virtuozzo templates; it can be applied only to EZ templates and to the private areas of those Containers that are based on an OS EZ template or have application EZ templates added to them. This has been done to further promote the usage of EZ templates in Parallels Virtuozzo Containers at the expense of outdated standard templates. This does not mean that Virtuozzo Containers 4.0 installations are not able to work with standard templates, as the Virtuozzo kernel provides backward compatibility with the previous version of VZFS.

Upgrading VZFS

It goes without saying that all new Virtuozzo Containers installations enjoy all the benefits of VZFS v2 without having to worry about compatibility with the previous VZFS version. On newly-installed systems both EZ templates and Container private areas are installed and created on the basis of VZFS v2.

And even if you are upgrading your existing Virtuozzo system to version 4.0 (and thus, to VZFS v2), this process remains almost wholly transparent for the administrator. Even if you do not know anything about VZFS and its versions, the legacy Containers will continue operating as usual on VZFS v1. For newly-created Containers to use VZFS v2 and all its advantages, it is sufficient to issue a single `vzpkg update cache` command to recreate the caches of the installed OS EZ templates. So what exactly happens to VZFS when a Virtuozzo Containers 3.0 or 3.0 SP1 system is upgraded to version 4.0?

Upgrading templates

The first thing to note is that the upgrade does not affect standard Virtuozzo templates in any way. Both these templates and Container private areas based on these templates will continue to operate on the previous version of VZFS, and there is nothing the Hardware Node administrator can or should do in this respect.

As to EZ templates, they *are* upgraded automatically to VZFS v2, and no additional actions are required for application templates. However, the OS EZ template caches on the basis of which new Containers are created will still use VZFS v1. So, you need to complete the following tasks to make all newly created Containers on the Hardware Node automatically use VZFS v2:

- Make sure that the value of the `VEFORMAT` parameter in the Virtuozzo global configuration file (`/etc/vz/vz.conf`) is set to `vz4`:

```
# grep /etc/vz/vz.conf
VEFORMAT="vz4"
```

- Recreate the OS EZ template caches on the basis of which new Containers will be created using the `vzpkg remove cache` and `vzpkg create cache` commands. For example, to upgrade the cache of the `fedora-core-8-x86` OS EZ template, you can run the following commands on the Hardware Node:

```
# vzpkg remove cache fedora-core-8-x86
# vzpkg create cache fedora-core-8-x86
```

From this moment on, when a Container is created on the basis of the `fedora-core-8-x86` OS EZ template, its private area will use VZFS v2. At any time you can revert to VZFS v1 by changing the value of the `VEFORMAT` parameter in the Virtuozzo configuration file (`/etc/vz/vz.conf`) from `vz4` to `vz3`.

Upgrading Container private areas

Upgrading templates is almost transparent, and the only thing where a manual intervention is possible is upgrading existing Containers to VZFS v2. Please keep in mind that this upgrading is not at all necessary to maintain the proper of operation of these Containers. Even though the corresponding EZ template has already been upgraded to VZFS v2, the Container can still use VZFS v1 and be perfectly compatible with the template. The process of upgrading such Containers can be regarded as an optimization only and as such can be planned for whatever convenient time after the upgrade of Virtuozzo proper.

When upgrading a Container to VZFS v2, first make sure that it is based on an OS EZ template. If this is not the case, the optimization is senseless. After you have decided on the Container you want to upgrade, you should unmount it and use the `vzpkg upgrade area` and `vzfsutil` commands to upgrade this Container to VZFS v2. For example, to upgrade Container 101 based on the `fedora-core-8-x86` OS EZ template to VZFS v2, you should:

- Make sure Container 101 is unmounted:

```
# vzctl status 101
VEID 101 exist unmounted down
```

- Upgrade the `fedora-core-8-x86` template area on the Hardware Node:

```
# vzpkg upgrade area fedora-core-8-x86
```

- Check that the `fedora-core-8-x86` template area has been successfully upgraded and upgrade the private area of Container 101:

```
# vzfsutil --upgrade --ctid=101 -t /vz/template /vz/private/101
```

To ascertain that Container 101 now uses VZFS v2, you can use one of the following ways:

- Execute the following command on the Hardware Node:

```
# ls -l /vz/private/CT_ID/fs/VERSION
lrwxrwxrwx ... /vz/private/122/fs/VERSION -> 005.004
```

  The number "`005.004`" in the command output indicates that the Container uses VZFS v2. VZFS v1 would be indicated by `005.003` instead.

- By checking the `VEFORMAT` parameter in the Container configuration file:

```
# cat /etc/vz/conf/101.conf | grep VEFORMAT
VEFORMAT="vz4"
```

  `vz4` specified as the value of this parameter indicates that Container 101 uses VZFS v2; otherwise, `vz3` would be specified.

Restrictions

When EZ templates are upgraded to VZFS v2, they remain perfectly compatible with those Containers that are based on the previous version of VZFS. As such, upgrading EZ templates cannot cause any trouble as regards the Hardware Node or Containers functioning.

On the other hand, the Containers based on VZFS v2 are not compatible any more with VZFS v1. So, if you, for example, have forcibly (as Parallels Virtuozzo Containers will not allow you to do otherwise) migrated such a Container to a Virtuozzo Containers 3.0 Hardware Node, it is not expected to start.

Virtuozzo Containers 4.0 checks the Container configuration file to determine the VZFS version to be present on the Hardware Node for the given Container to operate correctly. The VZFS version is specified as the value of the `VEFORMAT` parameter in the Container configuration file. If the Container private area is based on VZFS v2 (the `VEFORMAT` parameter is set to `vz4`), it should not be migrated or cloned to a Hardware Node where Virtuozzo Containers 4.0 has not been installed. There is no way to downgrade such a Container to VZFS v1. If you continue to have legacy Virtuozzo Nodes in your Virtuozzo Group, and you wish to maintain the ability to migrate your Containers to such Nodes, you should not upgrade these Containers to VZFS v2. Moreover, you can prevent the automatical applying of the VZFS v2 technology to all newly-created Containers on Virtuozzo 4.0 Nodes. To do this, alter the value of the `VEFORMAT` parameter in the Virtuozzo configuration file (`/etc/vz/vz.conf`) from `vz4` to `vz3`.

Another thing to bear in mind is the possibility of a Container private area growing in size even a Container user has not added anything to their Container, but rather deleted a file or just renamed it. The explanation is simple: as the structure of a shared directory has changed inside the Container, VZFS v2 creates separate shortcuts for each file from the template area instead of having just one file for the whole directory. Thus, deleting a file from inside a Container might cause the Container to occupy more space on the Hardware Node. This behavior is conditioned by the nature of VZFS v2 and is perfectly normal. However, it should be taken into account when deciding on Container disk quotas, because the Container private area makes part of the disk space included in the quota.

CHAPTER 12

Mastering Parallels Management Console

To leverage the full power of Parallels Management Console, it is important to be aware of those tasks that are much more convenient to perform through the Management Console interface than through the command line. The current chapter centers on the advanced Management Console features you can make use of while administering your Virtuozzo system.

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Configuring Offline Management Parameters

The offline management functionality ensures the Container manageability by means of one or more offline services from any browser at its own IP address. When offline management is enabled for a Container, this Container is said to be subscribed to one or more offline services, which means that one or more ports of its IP address are permanently active whatever the Container state. This is needed to ensure the Container manageability in its down state.

The currently supported services are `vzpp` (for managing Containers by means of Parallels Power Panel) and `vzpp-plesk` (for managing Containers by means of the Plesk control panel integrated with Parallels Power Panel). You can view the names of accessible services on your Hardware Node in Parallels Management Console by right-clicking the needed Hardware Node name and selecting **Tasks --> Manage Offline Services** on the context menu:

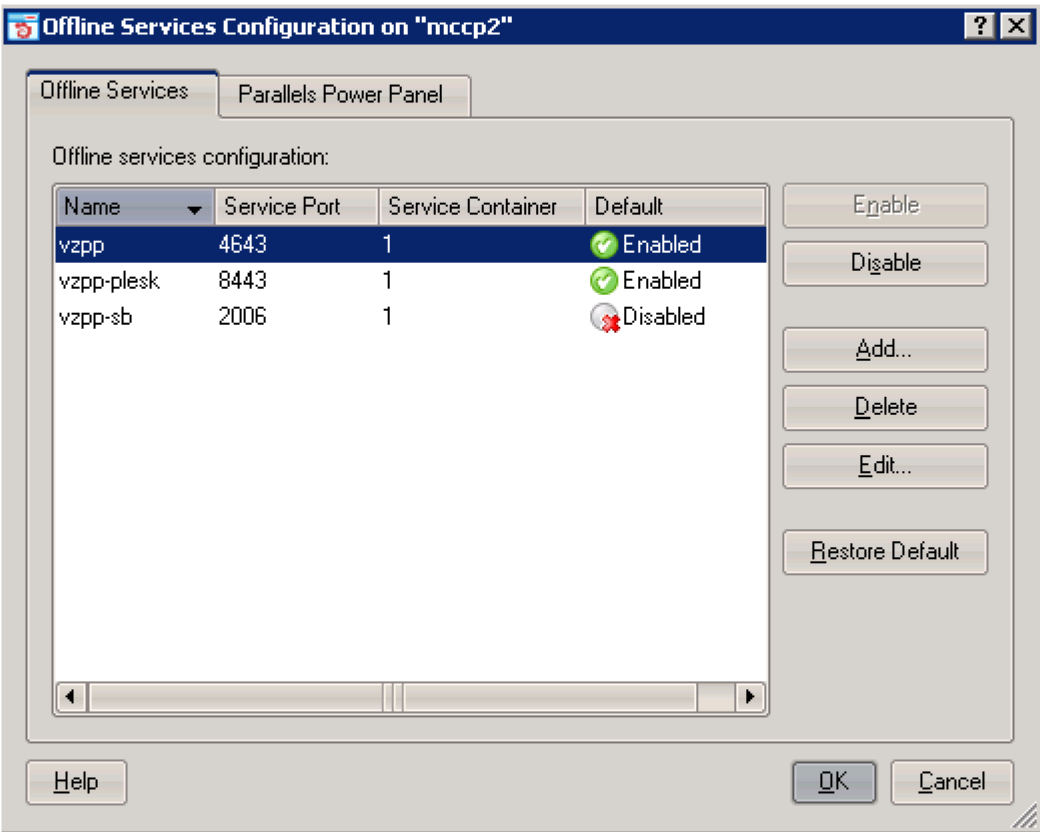

Figure 107: Management Console - Viewing Offline Services

All offline services currently available on your Hardware Node are listed in the **Offline services configuration** table in the displayed window. By default, offline management is enabled for all Containers residing on the Node.

To disable the offline management for a Container, do the following:

1 In the left pane of the Management Console window, select the **Virtuozzo Containers** item under the corresponding Hardware Node name.

2 In the right pane, right-click the Container on the Container list and select **Properties** on the context menu.

3 On the **Network** tab of the displayed window, select the **Offline Management** item and clear the **Enable offline management** check box:

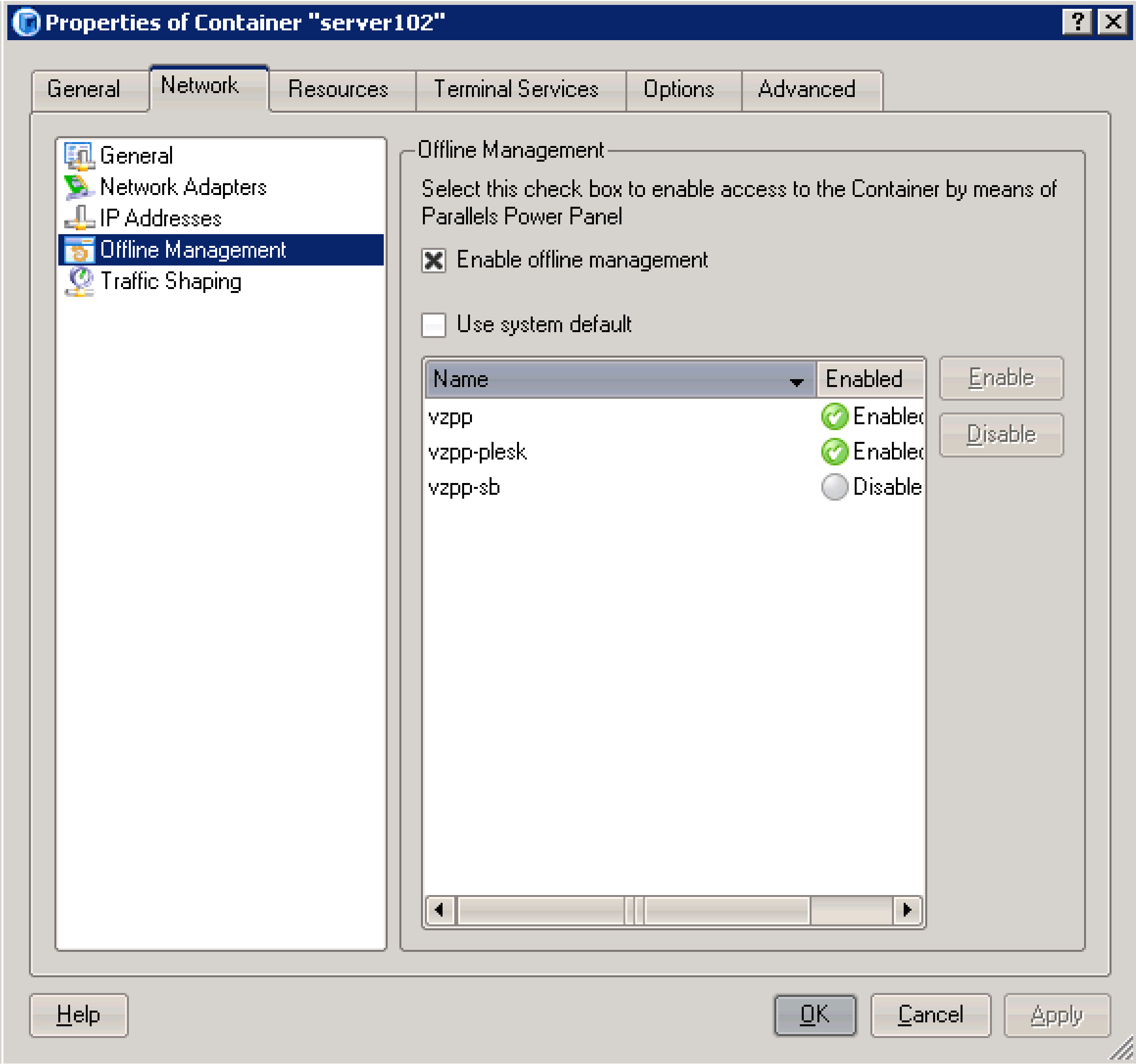

Figure 108: Management Console - Disabling Offline Management

On this screen you can also manage the offline services which will be available to the Container. To this effect:

- leave the **Enable offline management** check box selected;
- click the name of the corresponding offline service and use the the **Enable**/**Disable** buttons to subscribe the Container to or unsubscribe it from this service.

If you have made some changes to any of the offline services and wish to restore the system default values, click the **Apply System Defaults** button at the bottom of the **Properties** window.

4 Click **OK**.

You can disable the offline management for all Containers residing on the Node at once:

1 Right-click the Hardware Node name and select **Tasks** --> **Manage Offline Services**.

2 On the **Parallels Power Panel** tab of the **Offline Services Configuration** window, clear the **Enable Parallels Power Panel and Parallels Infrastructure Manager services** check box.

   On the **Offline Services** tab, you can also manage the offline services which will be available to all Containers on the Hardware Node:

   - select the corresponding offline service from the list of available services and use the **Enable**/**Disable** buttons to enable/disable this offline service to the Containers on the Node;
   - use the **Add**/**Delete**/**Edit** buttons to add a new offline service, to remove an existing offline service, or to configure the properties of any offline service in the **Offline services configuration** table, respectively.

   If you have made some changes to any of the offline services and wish to restore the system default values, click the **Restore Defaults** button.

3 Click **OK**.

Viewing Summary Pages

You can view the summary page for every Hardware Node. Click on the name of the Hardware Node you are interested in in the tree in the left pane of the Parallels Management Console main window or double–click the name of the Hardware Node in the list of Nodes in the right pane.

The upper part of the information pane contains shortcuts to the most important tasks you are likely to do. However, all the actions and operations are accessible via the Management Console toolbar, Action menu and context menus. The bottom part of the Hardware Node summary page includes three tabs: System, Network, and Disks. The System tab describes the OS distribution and kernel version, CPU(s), RAM, and swap information. The Network tab describes the Hardware Node network configuration: interfaces and IP addresses. The Disks tab describes available disks and their utilization.

You can also view summary pages for each and every Container. To open the summary page in the Container Manager, click on the name of the Container in the tree pane. The summary page is similar to that in the main Management Console window:

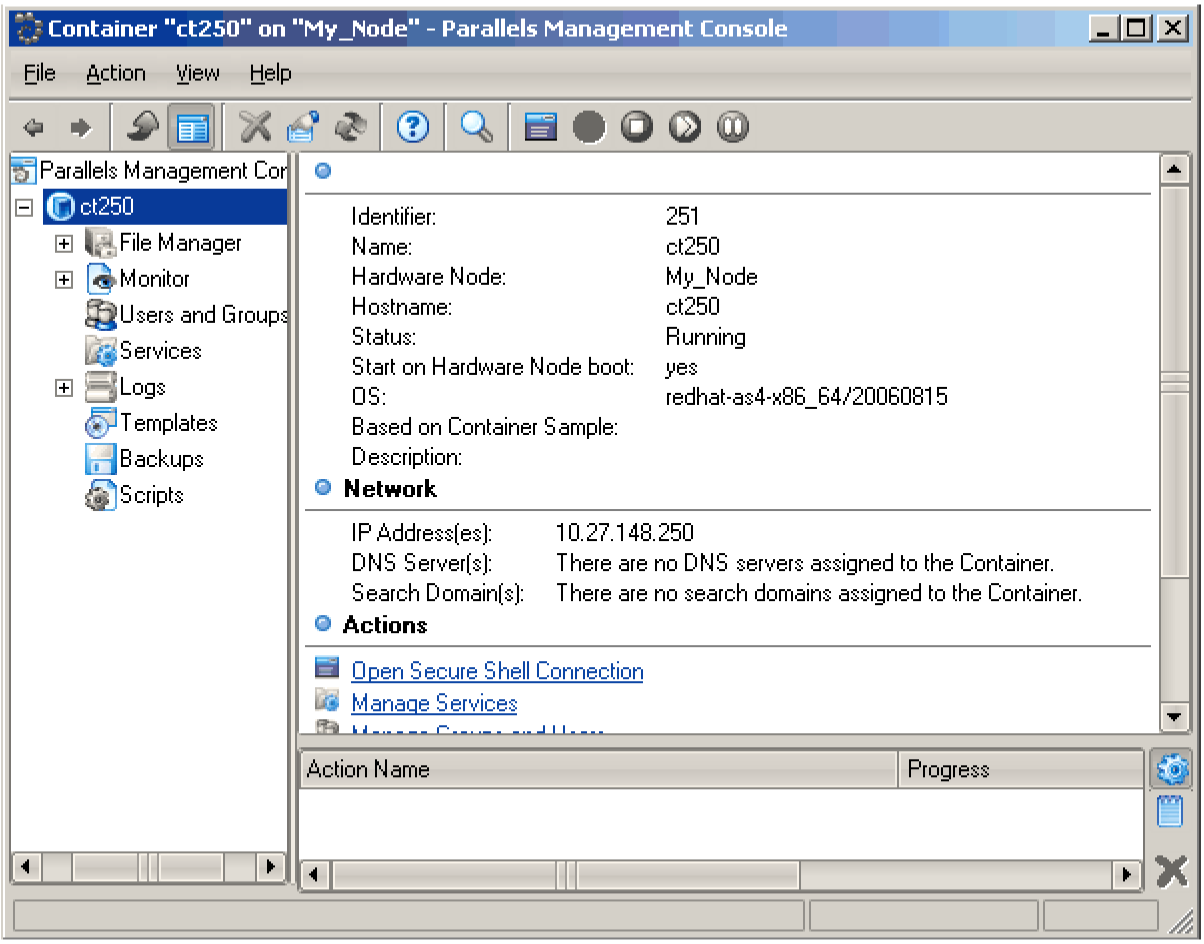

Figure 109: Management Console - Viewing Container Summary Page

It contains information about the Container ID, type of the Container, OS template, status (e. g. 'mounted', 'running'), Container class, and hostname. There is also a **Network** section describing the network configuration of the Container.

The shortcuts to the most common operations are located at the bottom of the summary page, in the **Actions** section.

Managing Users and Groups Inside Container

Parallels Management Console does not allow you to manage users or groups of the Host OS not to compromise the security of the Hardware Node. However, you can manage users and groups inside regular Containers with the help of Container Manager. All users and groups are adjustable. You can also add new users and groups.

To manage groups or users inside a Container, open the main tree for this Container, select the Users and Groups item, and click either the Groups or Users tab, respectively:

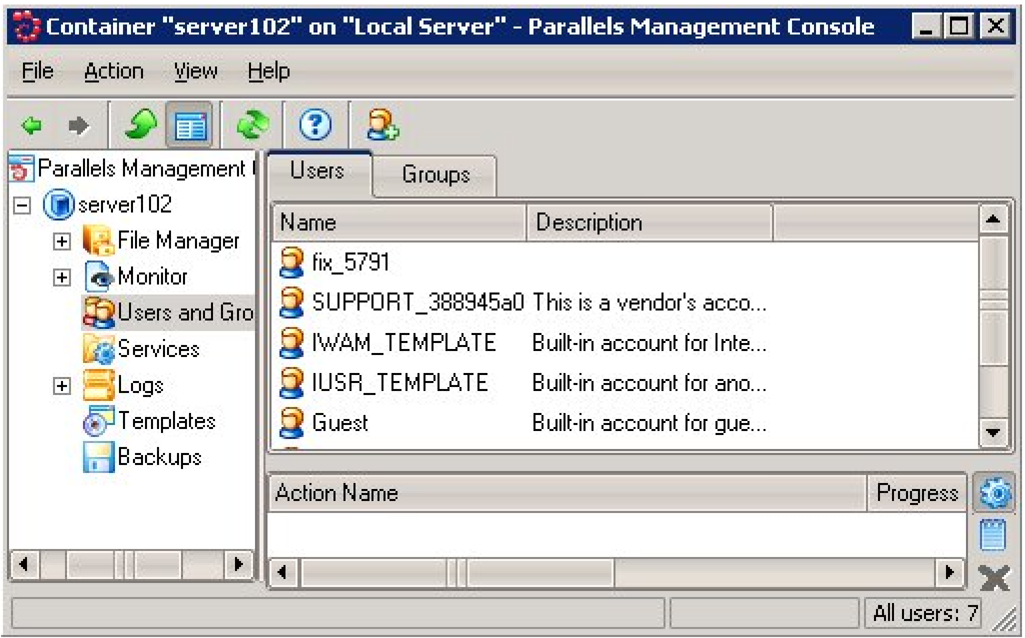

Figure 110: Management Console - Managing Users and Groups

To open the group properties dialog, double-click on the group name in the table of groups or select Properties on the context menu. To add a new user to the group, click the Add button. To remove a user from the group, select the user name and click the Remove button.

To add a new group, click the New group button on the toolbar (note that this button appears only if you are currently working with Container groups). Then enter the group name and press OK.

To delete a group, select its name in the table of groups and click the Delete button on the toolbar or select the Delete item from the context menu.

To add a new user, open the list of users and click the New user button at the top toolbar. Enter the user login (user name). This is the only mandatory parameter. You may also specify the home directory, the login shell, set the user description and password, add the user to one or more groups (see the Member Of tab). Then click OK.

To edit an existing user, double-click on the user name in the table of users or use the **Properties** item from the context menu. The user properties dialog is analogous to the **New User** dialog.

To delete a user, select its name in the table of users and click the **Delete** button at the top toolbar or select the **Delete** option in the context menu.

Configuring Firewall

You can limit access of Internet users to your Hardware Node. To enable the Hardware Node firewall, right-click the needed Node and select **Tasks** --> **Manage Firewall Settings** on the context menu.

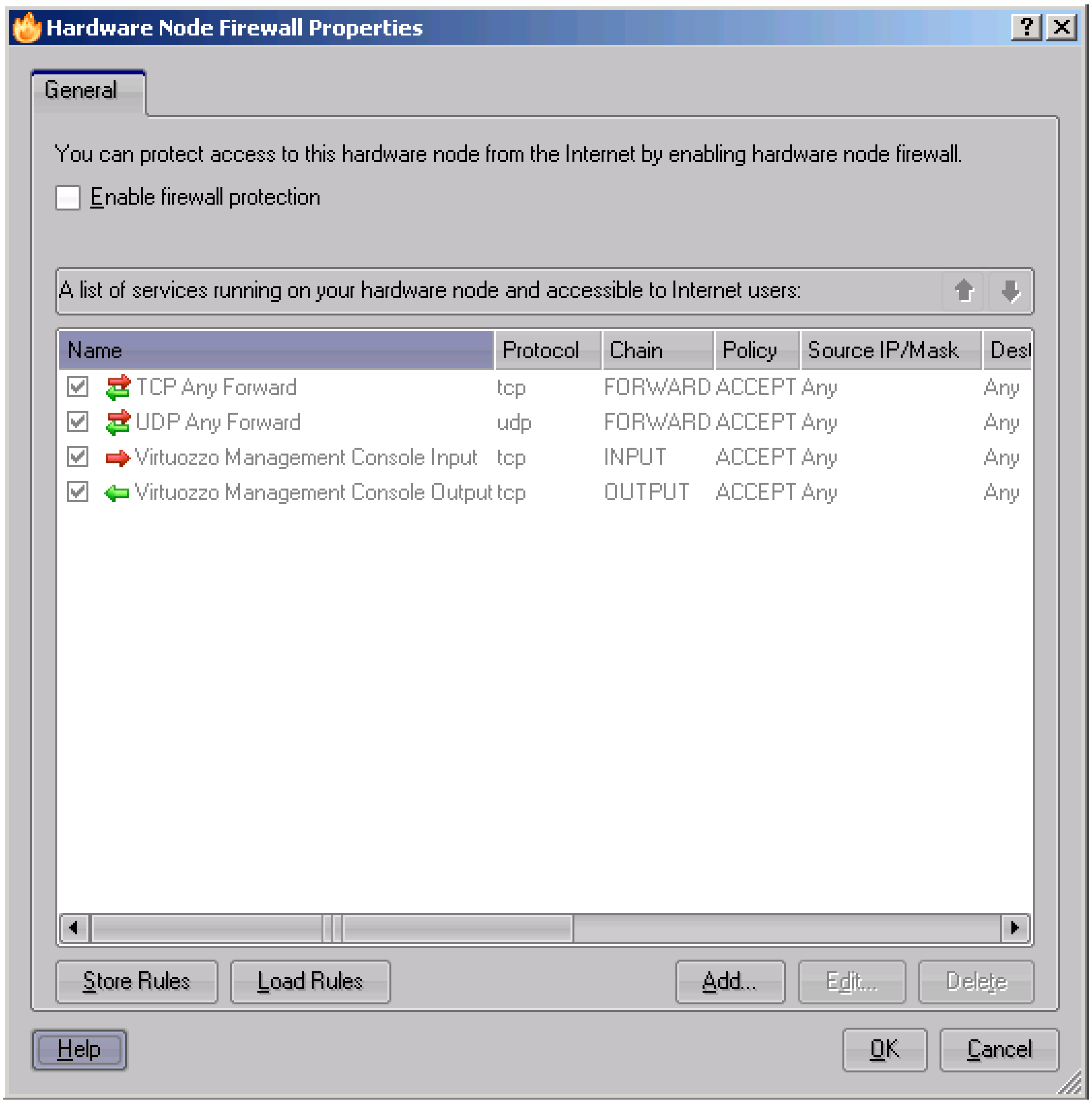

Figure 111: Management Console - Firewall Configuration Dialog

Several default rules are set for the Hardware Node, which are read-only. These rules are used to allow the Hardware Node to receive/send IP packets from/to different networks via TCP and UDP protocols and to enable Management Console connections to the Node.

In the **Hardware Node Firewall Properties** window, you can:

- Add your own rules with the **Add** button, for example, to provide access to certain services like SSH, Telnet, POP3, SMTP, HTTP, and FTP. You can also define rules that are more specific. Refer to your Linux documentation for more details on firewall configuration.

- Remove any rules (except for the default ones) form the existing list with the **Delete** button. To disable the rule temporary, unmark the check box opposite the rule name.
- Change any of the existing rules (except for the default ones) using the **Edit** button.
- Save any of the existing rules on your local computer with the **Store Rules** button or load new rules from a local file with the **Load Rules** button.

Managing the firewall configuration for a Container is identical to managing the firewall configuration for the Hardware Node in respect of adding or removing rules. To manage the firewall configuration for a Container, click the **Manage Firewall** link on the summary page of the Container Manager.

Each IP packet coming to a particular Container passes 2 firewalls: the `iptables` rules of the Host OS and the firewall rules of the given Container. An administrator of the Hardware Node sets up the Host OS `iptables` rules, and the end-users have no access to these rules.

Managing Mount Points

You can manage mount points through Parallels Management Console both for the Hardware Node and for each and every Container. To view the current list of mount points, click the **Manage Mounts** link on the summary page of either the Hardware Node or the necessary Container. Then use the **Add** button to add a new mount point, the **Remove From List** button to delete an existing mount point, or the **Edit** button to change an existing mount point. For example, after clicking the **Add** button, you will be presented with the following window:

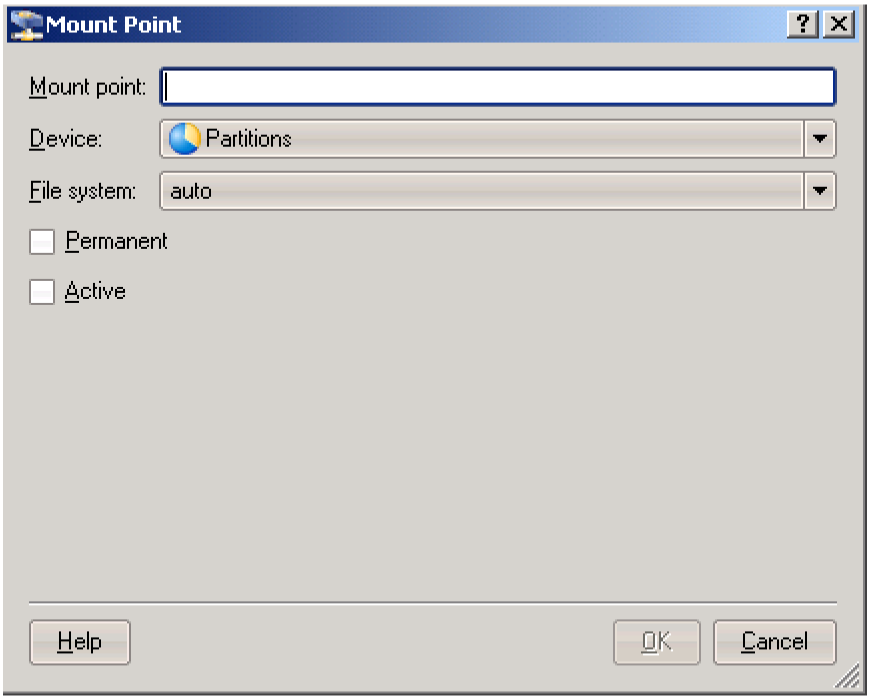

Figure 112: Management Console - Managing Mount Points

In this window you should:

- specify the directory where your file system is to be mounted the **Mount point** field (if the directory does not exist, it will be automatically created after clicking the **OK** button);
- choose the physical device where your file system resides in the **Device** list box.

If you mark a mount point permanent (the **Permanent** check box is selected), it means that this mount point will be automatically mounted on the system boot. If you mark a mount point active (the **Active** check box is selected), it will be mounted after you click the **OK** button in the **Mount Point** window.

Viewing System and Virtuozzo Logs

Parallels Management Console allows to view the logs which are maintained on the corresponding Hardware Node both for the Hardware Node itself and for a particular Container. The following log types are available for a particular Hardware Node in the Management Console main window:

Log type	Description
Alerts	Resource management system messages generated in case a Container exceeds its resources limits or disk quotas.
Events	All Container-related events (start, stop, migrate, mount, unmount, etc.).
Operations	Asynchronous tasks performed with any Container of the Hardware Node.
Virtuozzo	Full Virtuozzo chronicles, i.e. system messages.
Actions	All actions performed with the main Virtuozzo Container management utility `vzctl`: creating a new Container destroying an existing Container, starting and stopping a Container, running commands in a Container and adjusting the configuration parameters and limits for a Container.

For Containers, only the Events and Alerts and Tasks Log logs are available in the corresponding Container manager window.

In order to view the logs, do the following:

1 Expand the Logs folder in the main tree under either the Hardware Node name or the Container name and click the needed log type.

2 Specify the time period for which you would like to view the logs.

3 Click Search to display the list of log entries in the right pane of the window:

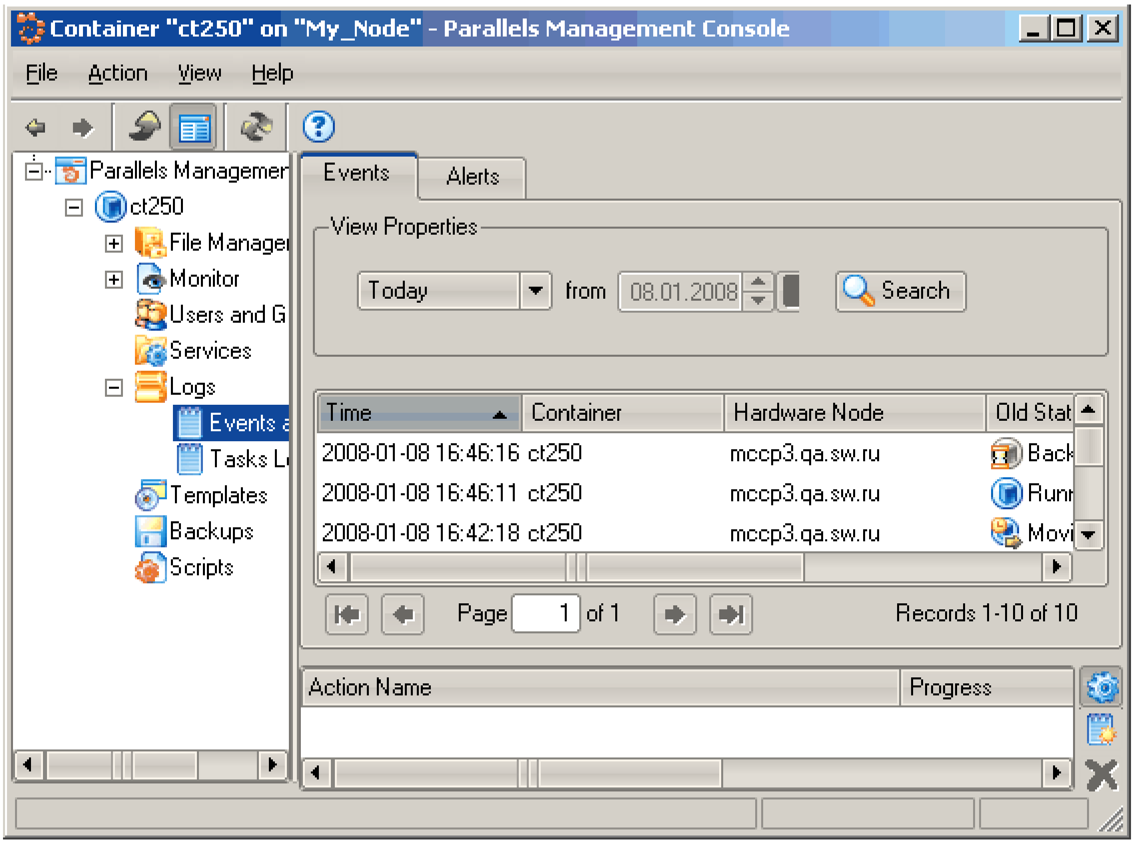

Figure 113: Management Console - Viewing Logs

Note: You can adjust the level of logging verbosity by defining the log_level parameter (from 0 to 2) in the Virtuozzo global configuration file (adjustable by selecting the Configuration item in the Hardware Node main tree).

Managing Files Inside Container

You cannot manage files directly on the Hardware Node by means of Parallels Management Console, but you can do it inside each and every Container by means of the Container manager window. After you click on the **File Manager** item in the Container main tree, you will see the list of folders and files of the Container root directory. Thus, this item corresponds to the / directory of the selected Container:

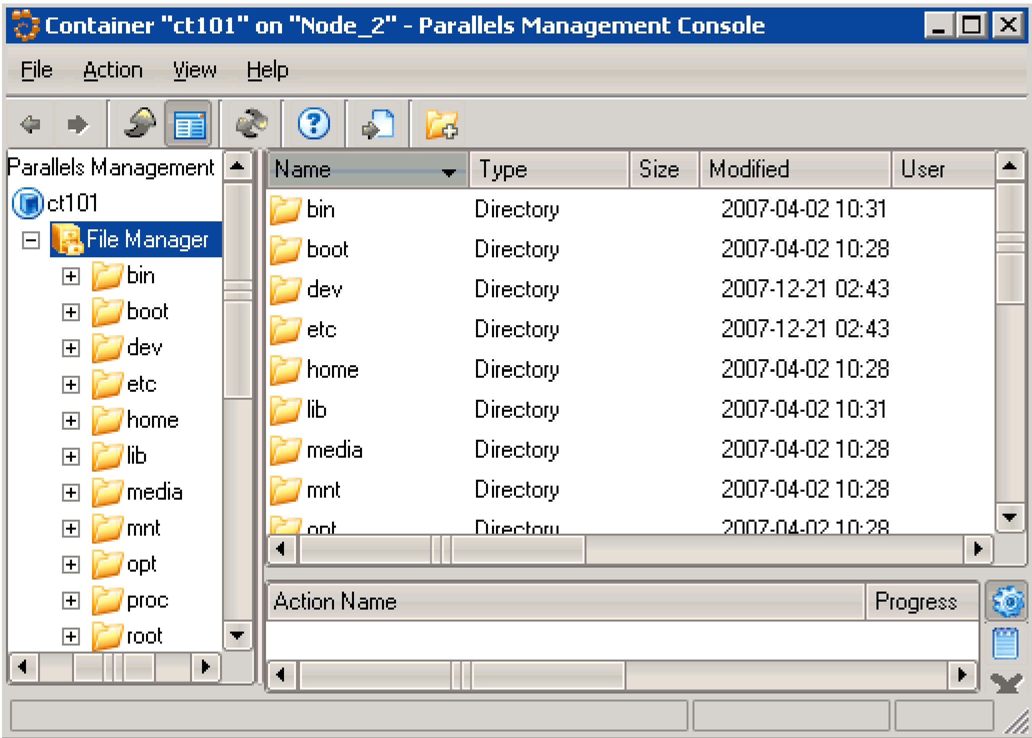

Figure 114: Management Console - Managing Files

The principles of working with the Container file manager are standard. You can move through the hierarchy of Container folders by double-clicking the folders names or selecting the necessary folders in the left pane. Use the menu items, toolbar buttons, table view, and context menus to perform the following tasks:

- View the contents of simple text files;
- View the principal information about a file/folder/symlink located in every directory and subdirectory of any depth in the given Container;
- Upload any number of files or whole directories from the local computer (the computer where Parallels Management Console is installed) to any folder of the given Container;
- Download any number of files from the given Container to the local computer;
- Create new folders in the Container;
- Copy files to another directory in the given Container;
- Move files to another directory in the given Container;
- Delete Container files;
- Rename Container files;

- Set permissions for Container files.

Parallels Management Console provides a user-intuitive interface for performing all these tasks.

Searching for Container

Usually there are a great number of Containers on your Hardware Node(s). To quickly find the necessary Container, go to the **Virtuozzo Containers** item, right-click it, and choose **Task** --> **Search for Containers**. The **Find Containers** window opens:

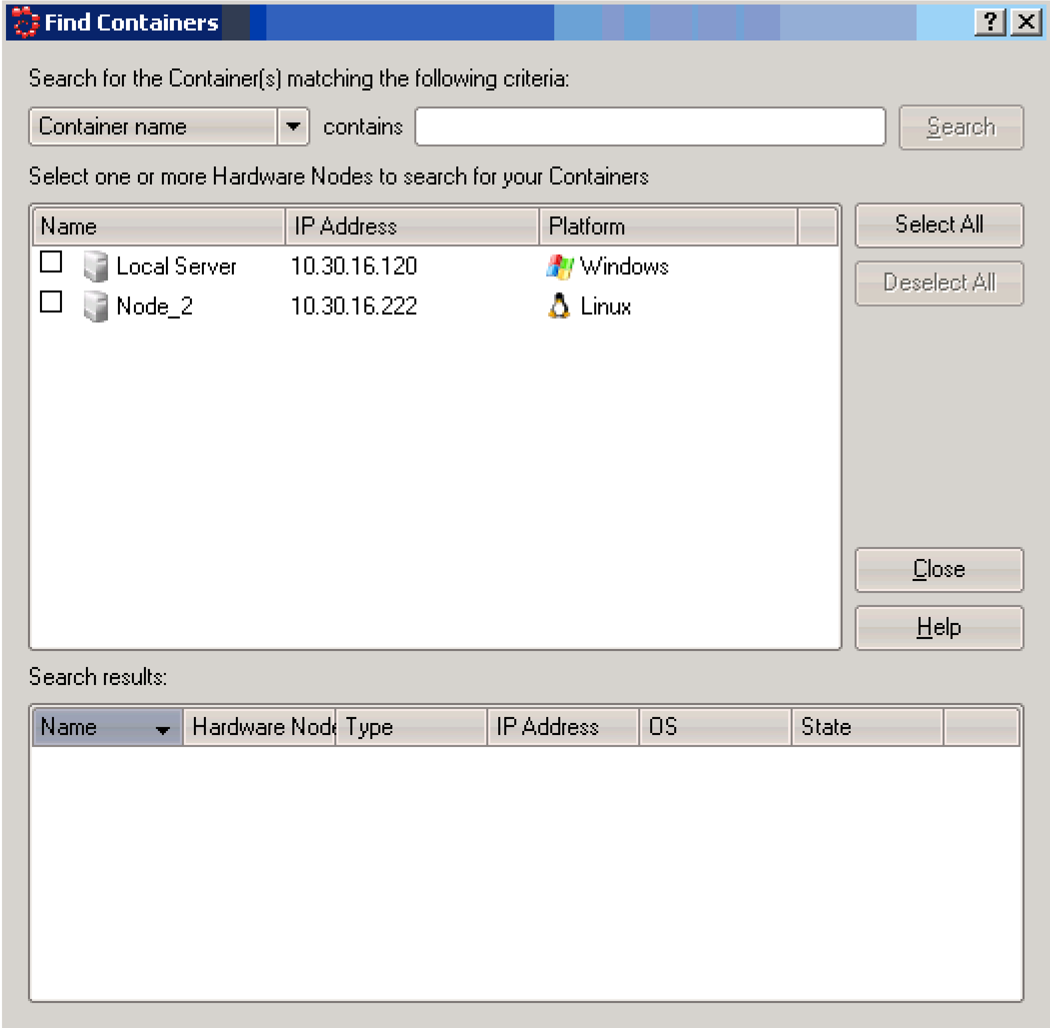

Figure 115: Management Console - Finding Container

This dialog window provides you with a list of Containers across one or several Hardware Nodes united by a common parameter value. This can be the Container ID, name, type, status, or IP address assigned to the Container.

You should indicate the parameter by which you wish to search for Containers on the upper left drop-down menu, and then the value of the parameter. If you choose to search for Containers by their state (status) or ID you will be presented with a list of predefined values of these parameters. It is connected with the fact that there is a fixed number of Container statuses, and Container IDs can be only of the integer type. By searching for Containers by their name or IP address, you can enter any string in the corresponding field. In this case the search results will display all the Containers whose name/IP address contain the specified string, even if only as a part.

You should also select the Hardware Node(s) where you wish to search for Containers with the specified characteristics. Containers from different Nodes matching the search criterion will be displayed in one and the same search result table. After you have selected the Hardware Node(s), click the **Search** button. The table will be populated at the bottom of the window.

The Containers in the **Search Results** table corresponding to the specified search criterion may also be sorted by a number of parameters, among which are their ID, name, the Hardware Node they belong to, their IP address, etc. To sort the Containers by a parameter, click the corresponding column name. Another click will reverse the sorting order.

From the **Search Results** table, you may also open the Container manager window by double-clicking the corresponding Container.

Managing Container Search Domains

Search domains is the list for hostname lookup. The search list is normally determined by the local domain name; by default, it contains only the local domain name. You can add other host names for a particular Container. A search query is performed by attempting to use each item in the list in turn until a match is found. Note that this process may be slow and may generate a lot of network traffic if the servers for the listed domains are not local, and that the query might time out if no server is available for one of the domains. The search list is currently limited to six domains with a total of 256 characters.

To view and/or edit the list of search domains for a particular Container, do the following:

1 Click on the **Virtuozzo Containers** item in the Parallels Management Console main tree.
2 As soon as the list of the Containers on this particular Hardware Node is displayed, right-click on the necessary Container name and select **Properties** on the context menu. (In case you are working with the Container Manager, click on the **Manage Container Configuration** link at the Container dashboard).
3 Click the **Network** tab in the **Properties of Containers** window.
4 Under the **Search domains** group in the right part of the window, use the **Add**, **Remove**, and **Properties** buttons to add, delete, or edit search domains, respectively.

CHAPTER 13

Troubleshooting

This chapter provides the information about those problems that may occur during your work with Parallels Virtuozzo Containers and suggests the ways to solve them, including getting technical support from Parallels.

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Problems With Container Operation 386
Problems With Physical Server Migration 387
Miscellaneous Problems 387
Getting Technical Support 388
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General Considerations

The general issues to take into consideration when troubleshooting your Virtuozzo system are listed below. You should read them carefully before trying to solve more specific problems.

- Make sure a valid license is always loaded on the Hardware Node. If your license has expired and the grace period is over, all the Containers on your Node will be stopped!
- You should always remember where you are located now in your terminal. Check it periodically using the `pwd`, `hostname`, `ifconfig`, `cat /proc/vz/veinfo` commands. One and the same command executed inside a Container and at the Hardware Node can lead to very different results! You can also set up the `PS1` environment variable to show the full path in the `bash` prompt. To do that, add these lines to `/root/.bash_profile`:

```
PS1="[\u@\h \w]$ "
export PS1
```

- If the Hardware Node slows down, use `vmstat`, `ps` (`ps axfw`), `dmesg`, `top` (`vztop`) to find out what is happening, never reboot the machine without investigation. If no thinking helps restore the normal operation, use the Alt+SysRq sequences to dump the memory (`showMem`) and processes (`showPc`).
- If the Hardware Node was incorrectly brought down, on its next startup all the partitions will be checked and quota recalculated for each Container, which dramatically increases the startup time.
- Do not run any binary or script that belongs to a Container directly from the Hardware Node, for example, do not ever do that:

```
cd /vz/root/99/etc/init.d
./httpd status
```

Any script inside a Container could have been changed to whatever the Container owner chooses: it could have been trojaned, replaced to something like `rm -rf`, etc. You can use only `vzctl exec/vzctl enter` to execute programs inside a Container.

- Do not use init scripts at the Hardware Node. An init script may use `killall` to stop a service, which means that all similar processes will be killed in all Containers! You can check `/var/run/Service.pid` and kill the correspondent process explicitly.
- You must be able to detect any rootkit inside a Container. It is recommended to use the `chkrootkit` package for detection (you can download the latest version from www.chkrootkit.org), or at least run

```
rpm -Va|grep "S.5"
```

to check up if the MD5 sum has changed for any RPM file.

You can also run `nmap`, for example:

```
# nmap -p 1-65535 192.168.0.1

Starting nmap V. 2.54BETA22 ( www.insecure.org/nmap/ )
Interesting ports on  (192.168.0.1):
(The 65531 ports scanned but not shown below are in
  state: closed)
Port       State       Service
21/tcp     open        ftp
22/tcp     open        ssh
80/tcp     open        http
```

```
111/tcp    open        sunrpc

Nmap run completed -- 1 IP address (1 host up) scanned
  in 169 seconds
```

to check if any ports are open that should normally be closed.

That could however be a problem to remove a rootkit from a Container and make sure it is 100% removed. If you're not sure, create a new Container for that customer and migrate his/her sites and mail there.

- Check the `/var/log/` directory on the Hardware Node to find out what is happening on the system. There are a number of log files that are maintained by the system and Parallels Virtuozzo Containers (the `boot.log`, `messages`, `vzagent.log` log files, etc.), but other services and programs may also put their own log files here depending on your distribution of Linux and the services and applications that you are running. For example, there may be logs associated with running a mail server (the `maillog` file), automatic tasks (the `cron` file), and others. However, the first place to look into when you are troubleshooting is the `/var/log/messages` log file. It contains the boot messages when the system came up as well as other status messages as the system runs. Errors with I/O, networking, and other general system errors are reported in this file. So, we recommend that you turn to the `messages` log file first and then proceed with the other files from the `/var/log/` directory.
- Subscribe to bug tracking lists, at least for Red Hat. You should keep track of new public DoS tools or remote exploits for the software and install them into Containers or at Hardware Nodes.
- When using `iptables`, there is a simple rule for Chains usage to help protect both the Hardware Node and its Containers:
  - use INPUT, OUTPUT to filter packets that come in/out the Hardware Node;
  - use FORWARD to filter packets that are designated for Containers.

Kernel Troubleshooting

Using ALT+SYSRQ Keyboard Sequences

Press ALT+SYSRQ+H (3 keys simultaneously) and check what is printed at the Hardware Node console, for example:

```
SysRq: unRaw Boot Sync Unmount showPc showTasks showMem loglevel0-8 tErm kIll
killalL Calls Oops
```

This output shows you what ALT+SYSRQ sequences you may use for performing this or that command. The capital letters in the command names identify the sequence. Thus, if there are any troubles with the machine and you're about to reboot it, please press the following sequences before pressing the Power button:

ALT+SYSRQ+M to dump memory info;

ALT+SYSRQ+P to dump processes states;

ALT+SYSRQ+S to sync disks;

ALT+SYSRQ+U to unmount filesystems;

ALT+SYSRQ+L to kill all processes;

ALT+SYSRQ+U try to unmount once again;

ALT+SYSRQ+B to reboot.

If the server is not rebooted after that, you can press the Power button.

Saving Kernel Fault (OOPS)

You can use the following command to check for the kernel messages that should be reported to Parallels Virtuozzo Containers developers:

```
grep -E "Call Trace|Code" /var/log/messages*
```

Then you should find kernel-related lines in the corresponding log file and figure out what kernel was booted when the oops occurred. Search backward for the "Linux" string, look for strings like that:

```
Sep 26 11:41:12 kernel: Linux version 2.6.18-8.1.1.el5.028stab043.1
(root@rhel5-32-build) (gcc version 4.1.1 20061011 (Red Hat 4.1.1-30)) #1 SMP
Wed Aug 29 11:51:58 MSK 2007
```

An oops usually starts with some description of what happened and ends with the Code string. Here is an example:

```
Aug 25 08:27:46 boar BUG: unable to handle kernel NULL pointer dereference at
virtual address 00000038
Aug 25 08:27:46 boar printing eip:
Aug 25 08:27:46 boar f0ce6507
Aug 25 08:27:46 boar *pde = 00003001
Aug 25 08:27:46 boar Oops: 0000 [#1]
Aug 25 08:27:46 boar SMP
Aug 25 08:27:46 boar last sysfs file:
Aug 25 08:27:46 boar Modules linked in: snapapi26(U) bridge(U) slm_dmprst(U)
ip_vzredir(U) vzredir(U) vzcompat(U) vzrst(U) i
p_nat(U) vzcpt(U) ip_conntrack(U) nfnetlink(U) vzfs(U) vzlinkdev(U)
vzethdev(U) vzevent(U) vzlist(U) vznet(U) vzstat(U) vzmo
n(U) xt_tcpudp(U) ip_vznetstat(U) vznetstat(U) iptable_mangle(U)
iptable_filter(U) ip_tables(U) slm_kill(U) slm_nofork(U) slm_core(U)
slm_skill(U) slm_if(U) vztable(U) vzdquota(U) vzdev(U) autofs4(U) hidp(U)
rfcomm(U) l2cap(U) bluetooth(U) sunrpc(U) ipv6(U) xt_length(U) ipt_ttl(U)
xt_tcpmss(U) ipt_TCPMSS(U) xt_multiport(U) xt_limit(U) ipt_tos(U)
ipt_REJECT(U) x_tables(U) video(U) sbs(U) i2c_ec(U) button(U) battery(U)
asus_acpi(U) ac(U) lp(U) floppy(U) sg(U) pcspkr(U) i2c_piix4(U) e100(U)
parport_pc(U) i2c_core(U) parport(U) cpqphp(U) eepro100(U) mii(U) serio_raw(U)
ide_cd(U) cdrom(U) ahci(U) libata(U) dm_snapshot
(U) dm_zero(U) dm_mirror(U) dm_mod(U) megaraid(U) sym53c8xx(U)
scsi_transport_spi(U) sd_mod(U) scsi_mod(U) ext3(U) jbd(U) ehci_hcd(U)
ohci_hcd(U) uhci_hcd(U)
Aug 25 08:27:46 boar CPU: 1, VCPU: -1.1
Aug 25 08:27:46 boar EIP: 0060:[<f0ce6507>] Tainted: P VLI
Aug 25 08:27:46 boar EFLAGS: 00010246 (2.6.18-028stab043.1-ent #1)
Aug 25 08:27:46 boar EIP is at clone_endio+0x29/0xc6 [dm_mod]
Aug 25 08:27:46 boar eax: 00000010   ebx: 00000001   ecx: 00000000   edx:
00000000
Aug 25 08:27:46 boar esi: 00000000   edi: b6f52920   ebp: c1a8dbc0   esp:
0b483e38
Aug 25 08:27:46 boar ds: 007b   es: 007b   ss: 0068
Aug 25 08:27:46 boar Process swapper (pid: 0, veid: 0, ti=0b482000
task=05e3f2b0 task.ti=0b482000)
Aug 25 08:27:46 boar Stack: 0b52caa0 00000001 00000000 b6f52920
00000000f0ce64de 00000000 02478825
Aug 25 08:27:46 boar 00000000 c18a8620 b6f52920 271e1a8c 024ca03800000000
00000000 00000000
Aug 25 08:27:46 boar 00000000 00000000 c18a3c00 00000202 c189e89400000006
00000000 05cb7200
Aug 25 08:27:46 boar Call Trace:
Aug 25 08:27:46 boar [<f0ce64de>] clone_endio+0x0/0xc6 [dm_mod]
Aug 25 08:27:46 boar [<02478825>] bio_endio+0x50/0x55
Aug 25 08:27:46 boar [<024ca038>] __end_that_request_first+0x185/0x47c
Aug 25 08:27:46 boar [<f0c711eb>] scsi_end_request+0x1a/0xa9 [scsi_mod]
Aug 25 08:27:46 boar [<02458f04>] mempool_free+0x5f/0x63
```

```
Aug 25 08:27:46 boar
Aug 25 08:27:46 boar [<f0c713c3>] scsi_io_completion+0x149/0x2f3 [scsi_mod]
Aug 25 08:27:46 boar [<f0c333b9>] sd_rw_intr+0x1f1/0x21b [sd_mod]
Aug 25 08:27:46 boar [<f0c6d3b9>] scsi_finish_command+0x73/0x77 [scsi_mod]
Aug 25 08:27:46 boar [<024cbfa2>] blk_done_softirq+0x4d/0x58
Aug 25 08:27:46 boar [<02426452>] __do_softirq+0x84/0x109
Aug 25 08:27:46 boar [<0242650d>] do_softirq+0x36/0x3a
Aug 25 08:27:46 boar [<024050b7>] do_IRQ+0xad/0xb6
Aug 25 08:27:46 boar [<024023fa>] default_idle+0x0/0x59
Aug 25 08:27:46 boar [<0240242b>] default_idle+0x31/0x59
Aug 25 08:27:46 boar [<024024b1>] cpu_idle+0x5e/0x74
Aug 25 08:27:46 boar ======================
Aug 25 08:27:46 boar Code: 5d c3 55 57 89 c7 56 89 ce 53 bb 01 00 00 00 83 ec
0c 8b 68 3c 83 7f 20 00 8b 45 00 8b 00 89 44 24 04 8b 45 04 89 04 24 8b 40 04
<8b> 40 28 89 44 24 08 0f 85 86 00 00 00 f6 47 10 01 75 0a 85 c9
Aug 25 08:27:46 boar EIP: [<f0ce6507>] clone_endio+0x29/0xc6 [dm_mod]
SS:ESP0068:0b483e38
Aug 25 08:27:46 boar Kernel panic - not syncing: Fatal exception in interrupt
```

All you need is to put the oops into a file and then send this file as part of your problem report to the Parallels support team.

Finding Kernel Function That Caused D Process State

If there are too many processes in the D state and you can't find out what is happening, issue the following command:

```
# objdump -Dr /boot/vmlinux-`uname -r` >/tmp/kernel.dump
```

and then get the process list:

```
# ps axfwln
  F UID   PID  PPID PRI NI  VSZ  RSS  WCHAN STAT TTY TIME COMMAND
100   0 20418 20417  17  0 2588  684      - R    ?   0:00 ps axfwln
100   0     1     0   8  0 1388  524 145186 S    ?   0:00 init
040   0  8670     1   9  0 1448  960 145186 S    ?   0:00 syslogd -m 0
040   0  8713     1  10  0 1616 1140 11ea02 S    ?   0:00 crond
```

Look for a number under the WCHAN column for the process in question. Then you should open `/tmp/kernel.dump` in an editor, find that number in the first column and then scroll backward to the first function name, which can look like this:

```
"c011e910 <sys_nanosleep>:"
```

Then you can tell if the process “lives” or is blocked into the found function.

Using Kexec and Kdump For System Troubleshooting

Virtuozzo Containers 4.0 comes with the support of a new crash dumping mechanism based on the following kernel components:

- `Kexec`: this component, if installed on the Hardware Node, allows you to directly reboot to a new kernel (also known as *capture kernel*) from the context of an already running one without going through the bootloader stage of the system boot process, which drastically reduces reboot-related system downtime. When used for troubleshooting purposes, `Kexec` can be configured to boot into a new kernel on the system crash while preserving the crashed kernel memory contents and passing the control over this contents to the capture kernel.
- `Kdump`: this component provides a highly reliable dump generation and capturing mechanism. It uses `Kexec` to fast boot into the capture kernel in a system crash event and, after the kernel is loaded, captures the kernel crash dump.

Currently, you can use `Kexec` and `Kdump` to troubleshoot Hardware Nodes running Linux distributions with 'RHEL 5'-based kernels installed (e.g. RHEL 5). To start using these components on your Hardware Node, you should perform the following operations:

1. Install the `kexec-tools` package on the Node. For example:

```
# rpm -ihv kexec-tools-1.8-1.i386.rpm
```

2. Open the bootloader configuration file for editing (`/etc/grub.conf`) and append the following string to the end of the kernel line:

   - If you are running the 32-bit or x86-64-bit version of Virtuozzo Containers:

```
"crashkernel=128M@16M"
```

   - If you are running the IA64-bit version of Virtuozzo Containers:

```
"crashkernel=256M@256M"
```

   `128M` and `256M` in the examples above denote the amount of memory to be reserved for the capture kernel (please keep in mind that this memory is taken from RAM and cannot be used by the system) and `16M` and `256M` indicate at what physical address the reserved memory section is to be started.

3 Reboot the Hardware Node:

```
# shutdown -r now
```

4 Enable the `Kdump` service on the Node:

```
# chkconfig kdump on
```

5 Start the `Kdump` service:

```
# service kdump start
```

Now in the case of a system crash, `Kexec` will boot to the capture kernel without clearing the crashed kernel memory and then pass the control to this kernel. `Kdump`, in its turn, will capture the dump and put it to the `/var/crash` directory on the Hardware Node. This directory is used by `Kdump` by default for storing system crash dumps. You can leave the default location or redefine it by editing the `Kdump` configuration file (`/etc/kdump.conf`). Anyway, you should make sure that the corresponding directory has enough free space to store system dumps.

In addition to storing kernel dumps on the local filesystem, `Kdump` can be configured to place crash dumps to the following locations:

- RAW disk partitions;
- dedicated filesystems (i.e. formatted partitions that are not used by the system);
- NFS mounted filesystems;
- remote systems (using `ssh` and `scp`).

For example, the following session demonstrates what tasks should be completed to start using a remote server for storing crash dumps. Setting a remote location for keeping dumps may prove useful when the local filesystem is corrupted and saving a crash dump to your local system may only worsen the situation:

1 Create a user on the remote server. This user should have the following rights and permissions in respect of the server:

- S/he should be able to log in to the remote server from the Hardware Node via passwordless SSH keys.
- As `Kdump` will move the created crash dumps to the default `/var/crash` directory on the remote server using the `scp` utility, the user should have the permissions to wright to this directory.

2 Add the following string to the `Kdump` configuration file (`/etc/kdump.conf`) on the Hardware Node:

```
"net <username>@<server>"
```

where <*username*> is the name of the user created on the remote server on Step 1 and <*server*> denotes the IP address or hostname of the remote server.

3 You can also change the default path on the remote server (`/var/crash`) where all kernel crash dumps will be collected by adding the following string to the `Kdump` configuration file:

```
"path <dump_path>"
```

where <*dump_path*> is the path to be used for storing crash dumps. In this case you should make sure that the user has the permissions to wright to the specified directory.

4 Set up the passwordless SSH host keys and distribute them to the remote server:

```
# service kdump propagate
```

5 Save the changes made to `Kdump`:

```
# service kdump restart
```

Problems With Container Management

This section includes recommendations on how to settle some problems with your Containers.

Failure to Create Container

An attempt to create a new Container fails. There is a message on the system console: `Cached package set XXX version YYY not found.`

Solution 1

The necessary OS template might be absent from the Hardware Node. Copy the template to the Hardware Node, install it, cache it, and try to create a Container once again.

Solution 2

The Container private area might not be pre-cached. In this case the `vzpkgcache` utility shall be used. Issue the command:

```
vzpkgcache
```

The utility looks for the OS templates installed on the Hardware Node and caches those that are not cached. After this, try to create a Container once again.

Failure to Start Container

An attempt to start a Container fails.

Solution 1

If there is a message on the system console: `parameters missing`, and the list of missed parameters follows the message, set these parameters using the `vzctl set --save` command (see Configuring Container (p. 46) for instructions). Try to start the Container once again.

Solution 2

If there is a message on the system console: `IP address is already used`, issue the `cat /proc/vz/veinfo` command. The information about the Container numeric identifier, Container class, number of Container's processes and Container IP address shall be displayed for each running Container. This shall also demonstrate that your Container is up, i.e. it must be running without any IP address assigned. Set its IP address using the command:

```
vzctl set CT_ID --ipadd IP_addr --save
```

where *ct_id* represents the Container numeric identifier and *IP_addr* represents an actual IP address.

Solution 3

Poor UBC parameters might prevent the Container from starting. Try to validate the Container configuration (see Validating Container Configuration (p. 165)). See what configuration parameters have caused the error and set appropriate values using the `vzctl set --save` command.

Solution 4

The Container might have used all its disk quota (either disk space or disk inodes). Check the Container disk quota (see the Managing Disk Quotas section and Chapter 7 for details) and increase the quota parameters if needed (see Setting Up Per-Container Disk Quota Parameters (p. 122)).

Solution 5

Run the `vzfsutil` utility to make sure that the VZFS symlinks inside the Container work correctly. For example:

```
vzfsutil --call –t /vz/template /vz/private/<CT_ID>
```

The complete reference on the `vzfsutil` utility is provided in the Parallels Virtuozzo Containers Reference Guide.

Solution 6

The Container administrator might have inadvertently modified, replaced, or deleted any file that is part of an application or OS template, which has brought about the Container malfunction. In this case, restore the file(s) with the `vzctl recover` command (see the Recovering Container section for details).

Solution 7

Restore the latest operable copy of the Container by means of the `vzarestore` utility (see the Backing Up and Restoring Container section for details).

Failure to Access Container From Network

Solution 1

The IP address assigned to this Container might be already in use in your network. Make sure it is not. The problem Container address can be checked by issuing the following command:

```
# grep IP_ADDRESS /etc/vz/conf/<CT_ID>.conf
IP_ADDRESS="10.0.186.101"
```

The IP addresses of other Containers, which are running, can be checked by running

```
cat /proc/vz/veinfo
```

Solution 2

Make sure the routing to the Container is properly configured. Containers can use the default router for your network, or you may configure the Hardware Node as rooter for its Containers.

Failure to Log In to Container

The Container starts successfully, but you cannot log in.

Solution 1

You are trying to connect via SSH, but access is denied. Probably you have not set the password of the `root` user yet or there is no such user. In this case, use the `vzctl set --userpasswd` command. For example, for Container 101 you might issue the following command:

```
# vzctl set 101 --userpasswd root:secret
```

Solution 2

Check forwarding settings by issuing the following command:

```
# cat /proc/sys/ipv4/conf/venet0/forwarding
```

If it is 0 then change it to 1 by issuing the following command:

```
# echo 1 > /proc/sys/ipv4/conf/venet0/forwarding
```

Failure to Back Up Container in Parallels Management Console

An attempt to back up a Container with a large amount of disk space (e.g. 6 Gb) by means of Parallels Management Console finishes with the following error message: `The request was timed out`. However, the backup process continues running and the Container backup is successfully created on the Backup Node after a while, which can be checked by exploring the `/vz/backup` directory on this Node, where all Container backups are stored by default.

Solution

The problem is caused by the fact that the timeout limit set by Parallels Agent for the Container backup process in Management Console has been reached. This limit is equal to 3600 seconds by default. You can increase the maximal backup timeout value by performing the following operations:

1 In Management Console, right-click on the Hardware Node name and select Tasks --> Manage Parallels Agent Configuration on the context menu.

2 In the left part of the displayed window, choose backm --> configuration --> timeouts.

3 Double-click the `backup` parameter in the right part of the Parallels Agent Configuration window and specify the needed time (in seconds) in the Parameter value field.

4 Click OK.

Failure to Display List of Container Backups

You created a number of Container backups on the Backup Node and now wish to view them. However, the process of displaying your Container backups takes a very long time or even goes into infinity.

Solution

By default, the timeout limit for the Container backup search process is set to a very high value - 3600 seconds, which makes the search process to run for 60 minutes before showing a list of available backups on the Backup Node. To reduce the time needed to display your Container backup list, you should decrease the backup search value. You can do it in the following way:

1 In Parallels Management Console, right-click on the Hardware Node name and select Tasks --> Manage Parallels Agent Configuration on the context menu.

2 In the left part of the displayed window, choose backm --> configuration --> timeouts.

3 Double-click the `search` parameter in the right part of the Parallels Agent Configuration window and specify the desired time (in seconds) in the Parameter value field.

Note: You are recommended to set the value of the `search` parameter to 300 seconds.

4 Click OK.

Problems With Container Operation

Timeout When Accessing Remote Hosts

A host is unreachable by the Virtuozzo Hardware Node or its Containers, though it can be reached from other computers.

Solution

Often these timeouts occur due to the fact that the Explicit Congestion Notification (ECN) mechanism of the TCP/IP protocol is on by default in Parallels Virtuozzo Containers and off in some other systems, which leads to their incompatibility. ECN is used to avoid unnecessary packet drops and for some other enhancements. If Virtuozzo Containers cannot connect to a host, turn off this mechanism:

```
# sysctl –w net.ipv4.tcp_ecn=0
net.ipv4.tcp_ecn = 0
```

Extraneous Backups Visible to Container in Parallels Power Panel

Sometimes the Back Up/Restore Container page in Parallels Power Panel shows backups not belonging to the given Container.

Solution

This happens when two or more Hardware Nodes have Containers with identical IDs hosted on them. If such Containers are backed up onto one and the same Backup Node, they will be able to see the backups of each other by means of Parallels Power Panel. To avoid this situation, you are recommended to have unique Container IDs throughout all your Hardware Nodes.

Problems With Physical Server Migration

Failure to Start iptables Modules After Physical Server Migration

iptables is broken in the Container after a physical server has been migrated.

Solution

The iptables service can work properly inside the Container that has resulted from a physical server migration only if the ipt_state module is loaded both on the Hardware Node and in the Container in question. The simplest way to do it is the following:

1 Stop Virtuozzo on the Node:

```
# service vz stop
```

2 Add ipt_state as another module name to the IPTABLES_MODULES parameter in the /etc/sysconfig/iptables-config file on the Node.

3 Restart iptables on the Node:

```
service iptables restart
```

4 Start Virtuozzo:

```
# service vz start
```

5 Add ipt_state as another module name to the IPTABLES parameter in the /etc/vz/vz.conf file on the Node.

6 Restart the Container:

```
#  vzctl restart CT_ID
```

To learn more on loading iptables modules, please turn to the Loading iptables Modules section (p. 339).

Miscellaneous Problems

Failure to Run vgscan Utility

The vgscan utility may not work on some Host operating systems using lvm2-compatible tools (for example, Fedora Core 2), if Virtuozzo is installed on such systems. To avoid the utility malfunction, make sure you have the lvm1-compatible tools installed on your Node.

Corrupted Pseudographics in Virtuozzo Utilities

Some Virtuozzo utilities (e.g. `install`, `vzup2date`, and others) employ pseudographical instead of simple character output during their operation. Certain terminal clients fail to display the pseudographics the way it was intended to be displayed. This has nothing to do with Virtuozzo, but with locale settings either on the Hardware Node or in the terminal client. You may try to solve this problem in one of the following ways:

Solution 1

Set the correct locale for your terminal.

Solution 2

Try to run the utility as

```
# LC_ALL=C utility_name
```

Solution 3

If you are connecting to the Node via a remote shell, please make sure the locale set in the remote terminal is the same as in the local one.

Getting Technical Support

Getting Assistance With Virtuozzo Containers installation

Parallels provides installation assistance for the Virtuozzo Containers software. Assistance with installation can be offered via e-mail or by using the *Virtuozzo Support Tunnel* tool:

- While communicating via e-mail, the Parallels support will attempt to answer any relevant questions you may have before the installation process is initiated. This includes the following:
  - Pre-requisites list;
  - Hardware compatibility;
  - Software compatibility.
- You can also install the *Virtuozzo Support Tunnel* tool on your physical server and use it for getting installation assistance from the Parallels support. Detailed information on the *Virtuozzo Support Tunnel* tool is provided in the Establishing Secure Channel to Parallels Support subsection (p. 392).

Preparing and Sending Questions to Technical Support

In most cases, the support team must rely on the customer's observations and communications with the customer in order to diagnose and solve the problem. Therefore, the detailed problem report is extremely important. You can submit a Virtuozzo-related support report by visiting the http://www.swsoft.com/en/support/virtuozzo/request/ web page and filling in the Online Support Form. When describing the problem, please do mention the following:

- Symptoms of the problem;
- When the problem began including the circumstances of the failure;
- Any changes you made to your system;
- Other information that may be relevant to your situation, such as the installation method;
- Specific hardware devices that may be relevant to your problem.

You can also make use of the Parallels Helpdesk support tool. To this effect:

1 Follow the https://helpdesk.swsoft.com/ link.
2 Register with the Parallels Helpdesk (if you have not done so before) by clicking the **Get Access to Parallels Helpdesk** link on the Helpdesk login page and following the instructions provided on the **Activate Your Support Account** screen.
3 Log in to the Helpdesk using the received credentials.
4 At the top of the **RT At Glance** screen, select the Virtuozzo component your problem relates to on the drop-down menu and click the **New Ticket in** button:
5 On the **Create New Ticket** screen, fill in the appropriate fields, describe your problem, and click the **Create** button to make a new support ticket.

Another way of getting help is to directly call us or visit one of our offices. The information about phone numbers, contact people and office addresses is available on the contact pages at http://www.swsoft.com/en/contact and http://www.swsoft.com/en/support/phone/.

Submitting Problem Report to Technical Support

Virtuozzo Containers 4.0 is shipped with a special utility - `vzreport` - allowing you to compile a detailed report if you have any Virtuozzo-related problems and to automatically send it to the Parallels support team. After receiving your report, the support team will closely examine your problem and make its best to solve the problem as quickly as possible.

`vzreport` has two modes of execution — full screen and command line. By default, the utility starts in the full screen mode. However, you can force the utility to run in the command line mode by specifying any option containing your contact information (e.g. `-n` denoting your name) or the problem report description (e.g. `-m` used to provide additional information on your problem). Detailed information on all the options that can be passed to `vzreport` in the command line is provided in the Parallels Virtuozzo Containers Reference Guide.

After running the `vzreport` utility in the full screen mode, the Problem Report Wizard is opened, which will guide you through a number of steps asking you to provide the necessary information to generate a problem report. On the Welcome to ... screen, just click Next to proceed with the wizard. You will be presented with the following window:

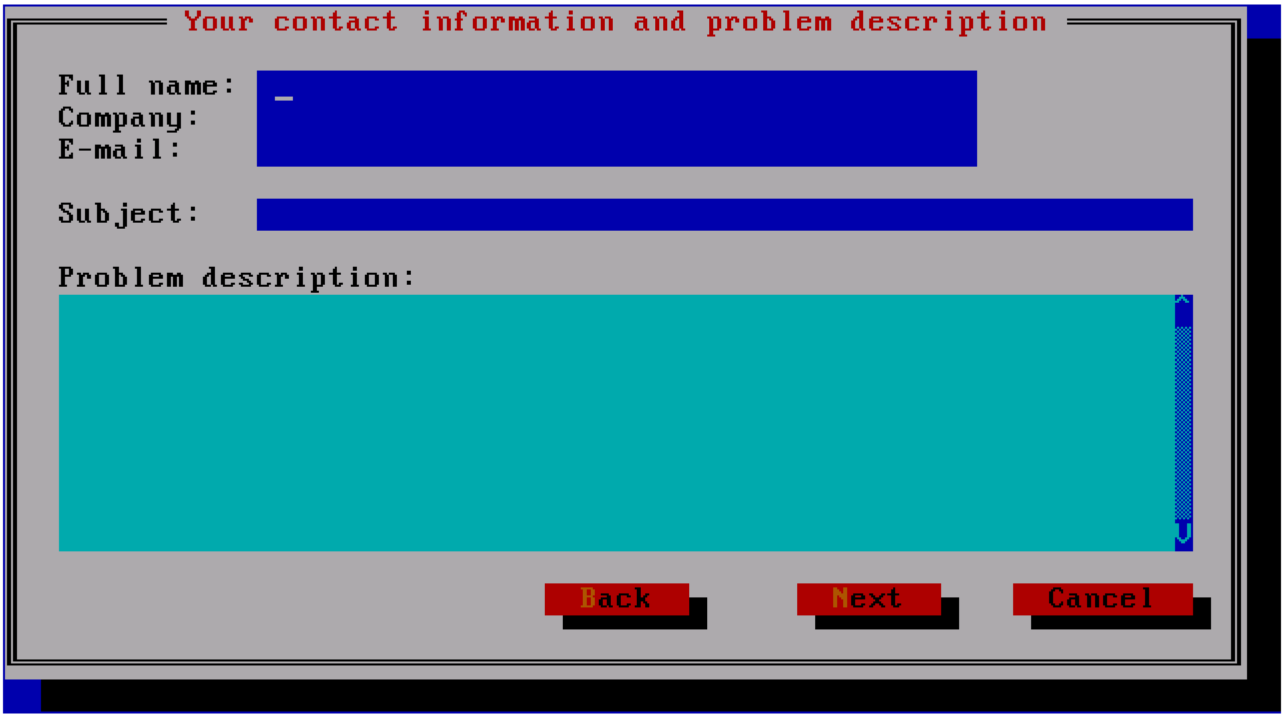

Figure 116: Submitting Problem Report - Providing Necessary Information

In this window you should enter your name, e-mail, and the name of your company into the corresponding fields. Make sure that you type a valid e-mail address; otherwise, the Parallels support team will not be able to contact you. In the Subject field, you should also specify what Virtuozzo problem you encountered and may provide additional information in the Problem description field which, in your opinion, can help solve the problem.

Clicking **Next** in the **Your contact information and issue description** window starts collecting Virtuozzo logs and information on your system and network settings into a special file. This file will be sent to the Parallels support team upon the completion of the wizard. The file does not contain any private information!

After the utility has gathered all the necessary information on your Node, the **Submit report** window is displayed:

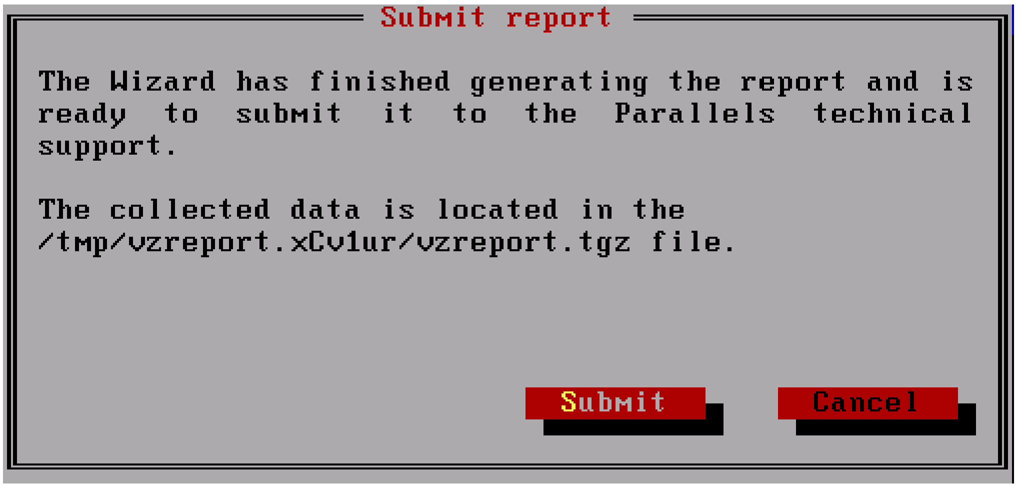

Figure 117: Submitting Problem Report - Sending Report to Parallels

In this window you can do one of the following:

- Click the **Submit** button to send your problem report to the Parallels technical support team. The report is dispatched directly to Parallels by using the HTTP protocol and port 80. However, if you use an HTTP proxy server for handling all your HTTP requests and wish your problem report to be sent via this server, you should specify the hostname or IP address of the server in the `/etc/vz/vz.conf` configuration file on the Hardware Node as the value of the `HTTP_PROXY` parameter. After the problem report has been successfully sent to the Parallels support, the **Congratulations** window is displayed informing you:
  - of the ID assigned to your report; you should use this ID every time you communicate with the Parallels support via e-mail or the Parallels Helpdesk support tool;
  - that an e-mail message providing you with detailed information on your problem report has been sent to the e-mail address you specified in the **E-mail** field of the **Your contact information and issue description** window.
- Click the **Cancel** button if you do not wish to dispatch the problem report to the support team at the moment for some reason or other. You can do it later on by manually sending the generated zip file to the Parallels support team. The full path to this file is indicated in the **Submit report** window.

Establishing Secure Channel to Parallels Support

Parallels Virtuozzo Containers provides you with a special tool - *Virtuozzo Support Tunnel* - which allows you to establish a private secure channel to the Parallels support team server. After establishing such a channel, the support team will be able to quickly and securely connect to your Node and diagnose and solve your problem. The secure connection to your server is achieved through a Virtual Private Network (VPN) created between the Parallels support team server and your Hardware Node.

To start using the *Virtuozzo Support Tunnel* tool, you should:

- Make sure the `openvpn` (version 2.0 and above) and `vzvpn` packages are installed on your Node. These packages are automatically installed on the Node during the installation of Virtuozzo Containers version 2.6.2 to 4.0. However, if you are running a Virtuozzo Containers version older than 2.6.2, you may need to manually copy these packages and install them on your Node.
- Make sure that port 80 is opened on the Hardware Node.
- Edit the `/etc/vzvpn/vzvpn.conf` file to specify the correct parameters for your proxy server, if you use any. Detailed information on these parameters is given in the **vzvpn Configuration File** subsection of the **Parallels Virtuozzo Containers Reference Guide**.

After you have completed the tasks above and in case you encountered a Virtuozzo-related problem, you can do the following to get assistance from the Parallels support:

1. Obtain a special certificate from Parallels which will uniquely identify you as a Virtuozzo user. Certificates are issued by Parallels in the form of files and should be installed on your Node by issuing the `vzvpn.sh key-install` *`certificate`* command where *`certificate`* denotes the name of the certificate file obtained from Parallels. You can get a certificate in one of the following ways:
    - Visit the http://www.swsoft.com/en/support/virtuozzo/certificates web site, fill up the **Request Virtuozzo Support Certificate** form, and click the **Submit** button. After a while, a certificate will be generated and sent to the email address you provided in the **Request Virtuozzo Support Certificate** form.
    - Contact the Parallels support team via email or by telephone and ask for a valid certificate.

2. After you are ready with the certificate installation, make sure your Hardware Node is connected to the Internet.
3. On the Node, execute the `/etc/init.d/vzvpn.sh start` command to establish a VPN between your Node and the Parallels support server.
4. Contact the Parallels support team (by telephone or via e-mail) and inform them of the problem you encountered. You should also mention that you have launched the *Virtuozzo Support Tunnel* tool and established a VPN to the Parallels support server.
5. After that, the Parallels support team will connect to your Node by using the secure VPN established, closely examine your problem, and make its best to solve the problem as quickly as possible.

Notes: 1. `Virtuozzo Support Tunnel` is implemented as a standard Linux service running in the background of your system. Therefore, to have this service running after your Hardware Node reboot, you should set it to the `autoboot` mode or start it manually again by executing the `/etc/init.d/vzvpn start` command.

2. To close the VPN session with the Parallels support server, you should issue the `/etc/init.d/vzvpn stop` command on the Node.

Setting Up Monitor Node

A regular monitoring of Hardware Nodes is an important part of their maintaining, administering, and troubleshooting. Parallels Virtuozzo Containers enables you to check the state of your Nodes in one of the following ways:

- By using the Monitor Node as a serial console to log the kernel state of the Hardware Node. This way of logging kernel messages is the most preferable one since it allows you to start monitoring the system and collecting messages right after the kernel boot process is started.
- By running the `vzrmond` daemon on the Monitor Node. This daemon provides the remote monitoring of the Hardware Node by constantly checking up the current state of the Node, verifying that the main Hardware Node parameters do not exceed their specified limits, and sending instant alerts via e-mail, ICQ, or SMS if anything goes wrong on the Node.
- By running the `vzstatrep` utility on the Monitor Node. This utility periodically analyzes the main resources consumption of one or several Hardware Nodes, generates statistic reports and graphics based on the analyzed information, and sends these reports and graphics at your e-mail address. You can then examine the received e-mail message to find out whether the Hardware Node is functioning trouble-free or a number of corrective actions should be performed in relation to some of its components.
- By using the `netconsole` module. This module can be configured to send console messages from the Virtuozzo kernel on the Hardware Node to the Monitor Node. However, in this case the process of monitoring the system and collecting kernel messages is started only after the kernel has been successfully loaded on the Hardware Node.

The following subsections describe each of these ways in detail.

Configuring Serial Console on Monitor Node

To set up a serial console on the Monitor Node, you have to complete the following tasks:

- Install Linux on a dedicated server that is to be served as the Monitor Node. This server shall meet one requirement: you must be able to install a Linux distribution on it. Logging messages even from several Hardware Nodes requires neither a powerful CPU nor a large amount of RAM. However, if you plan to be connected to more than two Hardware Nodes, you may need a special multi-port serial card. Among the popular makes of multi-port serial cards are Cyclades-Z, Digiboard, Specialix, and Stallion. Consult your Linux distribution vendor on multi-port serial card compatibility issues.
- Connect the Hardware Nodes to the Monitor Node via a null-modem cable.
- Configure serial parameters on the Monitor Node and the Hardware Node.
- Configure the Hardware Node to send kernel messages to the Monitor Node.
- Start the message collector on the Monitor Node.
- Reboot the Hardware Node.

Configuring Serial Parameters on Monitor Node and Hardware Node

First, find out the serial port number used on the Monitor Node. The first serial port (COM1 in DOS) is represented by `/dev/ttyS0`, the second one (COM2 in DOS) – by `/dev/ttyS1`, and so on. If you are not sure about which serial port the cable is connected to, you may try on your own risk different ports in the commands given in this and next subsections. It may not be completely safe if you have some other hardware attached to a different serial port.

If you have the null-modem cable connected to the `/dev/ttyS1` port, issue the following command on the Monitor Node:

```
# stty 115200 cs8 -hupcl -cstopb cread clocal -crtscts -icrnl ixon \
       ixoff -opost -isig -icanon -iexten -echo \
       </dev/ttyS1 >/dev/ttyS1
```

This command will correctly configure the second serial port (`/dev/ttyS1`). Use the appropriate serial terminal name instead of `/dev/ttyS1` if the actual configuration differs.

Start the following command on the Monitor Node:

```
# cat /dev/ttyS1
```

Now find out which serial port is connected on the Hardware Node side. Issue the following commands to configure the serial line parameters on the Hardware Node and to send a message to the Monitor Node:

```
# stty 115200 cs8 -hupcl -cstopb cread clocal -crtscts ixon ixoff \
       -opost </dev/ttyS0 >/dev/ttyS0
# echo 123 > /dev/ttyS0
```

The commands above assume that `/dev/ttyS1` is used on the Monitor Node and `/dev/ttyS0` is used on the Hardware Node. Change the commands appropriately if the actual configuration differs.

If you did everything right, you shall see “123” on the Monitor Node now.

Preparing Hardware Node for Sending Messages

Now you should pass the `console=ttyS0,115200 console=tty` parameters to the kernel on each start of the Hardware Node. In case you are using the LILO boot loader, add the following line into the Virtuozzo section of the `/etc/lilo.conf` configuration file:

```
append="console=ttyS0,115200 console=tty"
```

and run `/sbin/lilo` to activate the changes.

With the GRUB loader, it is enough to modify the `/boot/grub/grub.conf` configuration file by adding the needed parameters to the line beginning with `kernel` inside the Virtuozzo section of the file. For example:

```
kernel /vmlinuz-2.4.0-stab1.2.777 ro console=ttyS0,115200 console=tty
```

Note: You must not remove any of the existing parameters in the kernel line of the `grub.conf` configuration file.

Parallels Virtuozzo Containers 4.0 includes a special Virtuozzo watchdog module, which is off by default. However, if you set up a Monitor Node, it is very important to have this module running since it logs the kernel state every minute. In order to make Virtuozzo Containers 4.0 load this module automatically, edit the `/etc/vz/vz.conf` file and change the value of the `VZWDOG` parameter from `no` to `yes`. The corresponding line should look like the following:

```
# grep ^VZWDOG /etc/vz/vz.conf
VZWDOG=yes
```

Starting Messages Collection on Monitor Node

The kernel messages from the Hardware Node may be collected by reading from the serial terminal on the Monitor Node. The simplest way to collect and to store them is by executing the following command:

```
# cat /dev/ttyS1 > /var/log/vzmessages.hn1 &
```

on the Monitor Node. This way the messages will be stored in the `/var/log/vzmessages.hn1` file.

However, it is recommended to use the `ttylogd` serial console daemon to maintain serial log files. This daemon is launched by the `/etc/init.d/ttylogd` script on the system startup and uses the `/etc/ttylogd.conf` file for the correct parameters. Thus, all you need to do to automate the messages collection on the Monitor Node is to install `ttylogd` and edit appropriately its configuration file.

First, install the daemon on the Monitor Node. The corresponding package can be found on your Virtuozzo Containers 4.0 4.0 CD, DVD, or in your local distribution directory in the `/virtuozzo/RPMS` subdirectory:

```
# rpm -ihv ttylogd-3.0.0-2.swsoft.i386.rpm
Preparing...            ########################################### [100%]
   1:ttylogd            ########################################### [100%]
```

Now, take a look at the `/etc/ttylog.conf` file. It must comprise a number of string sections of the following type:

```
# Settings for ttyS0
# PORT1=/dev/ttyS0
# HOST1=ts2
# LOG1="/var/log/console-${HOST1}.log"
```

The value of the `PORTX` parameter is the serial console device on the Monitor Node;

The value of the `HOSTX` parameter is the name of the Hardware Node to be monitored. This parameter is optional, it is used for convenience.

The value of the `LOGX` parameter is the path to the file that will accumulate messages coming to the specified serial console from the Hardware Node. You may use the `${HOSTX}` variable to synchronize the name of the file with the name of the Hardware Node.

You must have as many such sections as the number of Nodes you wish to monitor. Copy and paste the needed number of these sections in the `ttylogd.conf` configuration file. Apply one and the same number after "`PORT`", "`HOST`", and "`LOG`" throughout each section, and increment this number with each new section. Edit the values of the "`PORT`", "`HOST`", and "`LOG`" parameters appropriately for each and every Hardware Node to be monitored and remove the hash marks before them. Then modify the DAEMONS="1 2" line to include all the numbers (separated by spaces) you used in your sections after the "`PORT`", "`HOST`", and "`LOG`" parameters. Save the file.

You may also consult the `ttylogd(8)` and `ttylog.conf(5)` manual pages.

Checking That Logging Works

Now reboot the Hardware Node. After the Hardware Node is up, check the file on the Monitor Node where the messages are stored (for example, `/var/log/vzmessages.hn1`). The file should contain the messages printed by the kernel during the boot-up.

Upon loading, the Virtuozzo watchdog module should produce to the log file the output similar to the one below:

```
MODULES="$PRELOAD_MODULES vzfs vzmon vzdquota vzdev vzwdog"
*** VZWDOG: time 1034715427.628385 uptime 994993 \
CPU 0 $Revision: 1.1.2.1 $ ***
           CPU0
  0:     994995    IO-APIC-edge  timer
  1:          2    IO-APIC-edge  keyboard
  8:          1    IO-APIC-edge  rtc
 14:          2    IO-APIC-edge  ide0
 21:       1999    IO-APIC-level  eth0
 26:      11037    IO-APIC-level  aic7xxx
 27:         16    IO-APIC-level  aic7xxx
[a lot of lines suppressed]
```

Setting Up netconsole

The `netconsole` module allows you to send the console messages from the Virtuozzo kernel installed on the Hardware Node to the Monitor Node. To prepare this module for use in your network environments, you should perform the following operations:

- set up the `netconsole` module on the Hardware Node to be monitored;
- configure the Monitor Node to collect messages from the `netconsole` module on the Hardware Node.

Both operations are described in the following subsections in detail.

Notes: 1. The `netconsole` module uses the UDP (User Datagram Protocol) transport protocol to send kernel messages from the Hardware Node to the Monitor Node. As this protocol provides simple but unreliable message services, you are highly recommended to have both Nodes located as close to each other as possible (best of all - in one and the same network segment) to ensure that all kernel messages can reach the Monitor Node.

2. Since the `netconsole` module allows you to monitor the system and collect kernel messages only after the kernel is successfully loaded and the corresponding NIC card is initialized, we recommend that you set up a serial console and use it as the primary tool for monitoring your system. Configuring the Monitor Node as a serial console enables you to start collecting the Node kernel logs right after the kernel boot process is started.

Preparing Hardware Node for Sending Kernel Messages

First, you should set up the `netconsole` module on the Hardware Node you wish to monitor. Depending on the Linux distribution installed on your Node, the operations you have to perform to configure this module may slightly differ. Listed below are examples of how to set up the `netconsole` module for the major Linux distributions:

To configure the `netconsole` module on a Hardware Node running Red Hat Enterprise Linux 3 or 4:

1 Specify the IP address of the Monitor Node as the value of the `SYSLOGADDR` parameter in the `/etc/sysconfig/netdump` file. Assuming that your Monitor Node has the `192.168.0.100` IP address assigned, you can do it as follows:

```
SYSLOGADDR=192.168.0.100
```

2 Execute the following command on the Hardware Node:

```
# service netdump restart
```

To configure the `netconsole` module on a Hardware Node running Red Hat Enterprise Linux 5.1 and Fedora 8:

Note: For instructions on how to load the `netconsole` module on Hardware Nodes running Red Hat Enterprise 5.0, please see the information below.

---

1 Specify the IP address of the Monitor Node as the value of the `SYSLOGADDR` parameter in the `/etc/sysconfig/netconsole` file. Assuming that your Monitor Node has the `192.168.0.100` IP address assigned, you can do it as follows:

```
SYSLOGADDR=192.168.0.100
```

2 Execute the following command on the Hardware Node:

```
# service netconsole restart
```

To configure the `netconsole` module on a Hardware Node running SUSE Linux Enterprise Server 10:

1 Make sure that the `netconsole-tools` RPM package is installed on the Hardware Node.

2 Run the `netconsole-server` utility on the Hardware Node and specify the Monitor Node IP address as its parameter. For example:

```
# netconsole-server 192.168.0.100
```

To configure the `netconsole` module on Hardware Nodes running other Linux distributions, please see the documentation shipped with these distributions.

Another way of loading and configuring the `netconsole` module on your Hardware Node is to use the `modprobe` utility. The procedure of setting up `netconsole` using this utility is identical for all Linux distributions and can be used for the `netconsole` configuration irrespective of a Linux distribution installed on the Node. However, to configure the `netconsole` module with `modprobe`, you have to manually specify a number of parameters when running this utility (e.g. the Node IP address and the name of the network card installed on this Node). For example, you can issue the following command to prepare the `netconsole` module on your Node for sending kernel logs to the Monitor Node:

```
# /sbin/modprobe netconsole \
  netconsole=6666@192.168.0.50/eth0,514@192.168.0.100/00:17:31:D9:D7:C8
```

The parameters used in this command are explained below:

- `6666`: the port on the Hardware Node used for sending UDP messages.
- `192.168.0.50`: the IP address assigned to the Hardware Node.
- `eth0`: the name of the network interface card installed on the Hardware Node.
- `514`: the port on the Monitor Node used to listen to incoming UDP messages from the Hardware Node.
- `192.168.0.100`: the IP address assigned to the Monitor Node.
- `00:17:31:D9:D7:C8`: the MAC address of the Monitor Node (if you do not know how to find out the Monitor Node MAC address, please turn to the next subsection).

If you wish the `netconsole` module to automatically load on the Hardware Node boot up, you need to add the following string to the `/etc/rc.d/rc.local` script on the Node:

```
/sbin/modprobe netconsole \
netconsole=6666@192.168.0.50/eth0,514@192.168.0.100/00:17:31:D9:D7:C8
```

Determining Monitor Node MAC Address

You can execute the following command on your Hardware Node to learn the MAC address assigned to the Monitor Node (we assume that the Monitor Node has the `192.168.0.100` IP address assigned):

```
# /sbin/arp -n 192.168.0.100
Address          HWtype   HWaddress           Flags Mask   Iface
192.168.0.100    ether    00:17:31:D9:D7:C8   C            eth0
```

In the example above, the Monitor Node has the MAC address of `00:17:31:D9:D7:C8` assigned.

Starting Messages Collection on Monitor Node

The kernel messages sent by the `netconsole` module on the Hardware Node may be collected by dumping the data received on a UDP port on the Monitor Node. The simplest way to collect this data is by executing the following command on the Monitor Node:

```
# nc -l -u 514 > /var/log/netconsole_logs
```

This way the messages will be collected on the 514 UDP port (this is the same port you specified when setting up `netconsole` on the Hardware Node) and stored in the `/var/log/netconsole_logs` file on the Monitor Node. However, the collected messages will have no time stamps and the redirection to the file will become broken in the case of a Monitor Node reboot. So, we recommend that you use the `ttylogd` serial console daemon to maintain kernel messages on the Monitor Node.

Note: Some Linux distributions (e.g. SLES 10 SP1) include the `netcat` utility in their distributions instead of `nc`. If this is your case, use `netcat` to collect kernel messages coming from `netconsole` in the same way you would use the `nc` utility.

The `ttylogd` serial console daemon is used to effectively process kernel messages received from `netconsole` on the Monitor Node. This daemon is launched by the `/etc/init.d/ttylogd` script on the system startup and uses the `/etc/ttylogd.conf` file for the correct control parameters. Thus, all you need to do to automate the kernel messages collection on the Monitor Node is to install `ttylogd` and to edit appropriately its configuration file.

First, you should install the daemon on the Monitor Node if you have not done so before. The corresponding package can be found in the `/virtuozzo/RPMS` subdirectory on your Virtuozzo Containers 4.0 CD, DVD, or in your local distribution directory:

```
# rpm -ihv ttylogd-3.0.0-2.swsoft.i386.rpm
Preparing...            ########################################### [100%]
   1:ttylogd            ########################################### [100%]
```

Now take a look at the `/etc/ttylog.conf` file. It must comprise a number of string sections of the following type:

```
# Settings for netconsole
# PORT3=514
# HOST3=ts4
# LOG3="/var/log/console-${HOST3}.log"
```

The value of the `PORT`*X* parameter is the UDP port number on the Monitor Node used to listen to incoming kernel messages from your Hardware Node.

The value of the `HOST`*X* parameter is the name of the Hardware Node to be monitored. This parameter is optional, it is used for convenience.

The value of the `LOG`*X* parameter is the path to the file that will accumulate messages coming to the specified serial console from the Hardware Node. You may use the `${HOST`*X*`}` variable to synchronize the name of the file with the name of the Hardware Node.

You must have as many such sections as the number of Nodes you wish to monitor. Copy and paste the needed number of these sections in the `ttylogd.conf` configuration file. Apply one and the same number after "`PORT`", "`HOST`", and "`LOG`" throughout each section, and increment this number with each new section. Edit the values of the "`PORT`", "`HOST`", and "`LOG`" parameters appropriately for each and every Hardware Node to be monitored and remove the hash marks before them. Then modify the DAEMONS="1 2" line in this file to include only those numbers (separated by spaces) that are used in your sections after the "`PORT`", "`HOST`", and "`LOG`" parameters. Save the file.

After you have configured the `/etc/ttylog.conf` file, you should restart the `ttylogd` daemon for the changes made to this files to come into effect:

```
# service ttylogd restart
Shutting down ttylogd:                    [OK]
Starting ttylogd 514:                     [OK]
```

You may also consult the `ttylogd(8)` and `ttylog.conf(5)` manual pages.

Increasing Kernel Log Level

To increase the kernel verbosity on the Hardware Node to get more informative kernel messages on the Monitor Node, you can proceed as follows:

1 Check the current kernel log level:

```
# cat /proc/sys/kernel/printk
6     4     1     7
```

2 Set the log level to the maximum possible value:

```
# echo 8 4 1 8 >/proc/sys/kernel/printk
```

3 On Hardware Nodes running RHEL-based distributions, additionally edit the `KLOGD_OPTIONS` parameter in the `/etc/sysconfig/syslog` file as follows:

```
KLOGD_OPTIONS="-x -c 8"
```

4 If your Hardware Node has an SMP kernel installed, additionally execute the following command on the Node:

```
# echo 8 >/proc/sys/kernel/silence-level
```

You can permanently save the changes made to the kernel log level configuration by doing the following:

1 Adding the following string to the `/etc/sysctl.conf` file on the Hardware Node:

```
kernel.printk = 8 4 1 8
```

2 Specifying the `debug` parameter in the boot loader configuration file (`/etc/grub.conf` or `/etc/lilo.conf`) on the Hardware Node.

On Hardware Nodes with SMP kernels, you should also add the `silencelevel=8` string to the boot loader configuration file on the Node.

Checking That netconsole Logging Works

You can check that you have successfully set up `netconsole` by loading and unloading a certain kernel module on the Hardware Node and viewing the file on the Monitor Node where the messages are stored. The file should contain the messages printed by the kernel during the module loading/unloading. Assuming that all messages coming from `netconsole` are to be stored in the `/var/log/netconsole_logs` file For example, `netconsole` will send messages like the following during the `loop` module loading on the Hardware Node:

```
Jan 22 17:49:57 ts4 ttylogd v.2.1.0-5 started
Jan 22 06:14:58 ts4 loop: loaded (max 8 devices)
```

Preparing Monitor Node for Sending Alerts

The Monitor Node can also be configured to remotely check up the state of the Hardware Nodes – if they are running or down, as well as a number of vital parameters – and to send instant alerts via e-mail if anything goes wrong.

To this effect, it is necessary to install the `vzrmon` package on the Monitor Node, which are located on your Virtuozzo Containers 4.0 4.0 CD, DVD, or in your local distribution directory in the `/virtuozzo/RPMS` subdirectory. For example:

```
# rpm -ihv vzrmon-4.0.0-9.swsoft.i386.rpm
Preparing...            ###################################### [100%]
   1:vzrmon             ###################################### [100%]
```

Note: You might also need to install the `gnuplot` and `mutt` packages, if they are not already installed. If this is the case, you will receive the corresponding notification. These packages are not included with Parallels Virtuozzo Containers, as they are part of a standard Red Hat Linux distribution.

After the `vzrmon` package is installed, the `vzrmond` daemon is started on the Monitor Node. You should manually edit the `vzrmond` configuration file (see the next subsection for details) to define the list of Nodes to monitor and the way the alerts are sent. However, `vzrmond` needs to be able to remotely log in to the specified Node(s) without having to provide a root password. Therefore, you should provide each Node to be monitored with your authorized public SSH RSA key. It can be done in the following way. First, you should generate a pair of SSH keys – public and private:

```
# ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
/root/.ssh/id_rsa already exists.
Overwrite (y/n)? y
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
c6:19:a8:2c:67:31:15:e6:30:23:2b:8a:b0:63:77:8f \
root@dhcp-130.asplinux.ru
```

Note that you should leave an empty passphrase in the above procedure.

Next, transfer your public key to each Hardware Node you are going to monitor to the `/root/.ssh` directory (use some intermediary name for the file not to overwrite the corresponding file on the Hardware Node):

```
# scp /root/.ssh/id_rsa.pub \
root@dhcp-129.asplinux.ru:/root/.ssh/temp_name
The authenticity of host 'dhcp-129.asplinux.ru (192.168.1.129)' \
can't be established.
RSA key fingerprint is 01:fc:b6:e9:26:40:1f:1a:41:5f:7a:fb:cf:14:51.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'dhcp-129.asplinux.ru,192.168.1.129' \
(RSA) to the list \
of known hosts.
root@dhcp-129.asplinux.ru's password:
id_rsa.pub       100% |*****************************|   235      00:00
```

Finally, you should add the contents of the transferred file to the authorized_keys file in this very directory of the Hardware Node. Log in to the Hardware Node, go to the /root/.ssh directory and issue the following command in it:

```
# cat temp_name >> authorized_keys
```

Now the Monitor Node should be able to log in to this Hardware Node as root without having to provide the root password. You should copy the public RSA file of the Monitor Node to every Hardware Node to be monitored and add its contents to the authorized_keys file in the /root/.ssh directory.

Using External Applications for Sending Alerts

Along with sending e-mail messages, vzrmond allows you to use external instant messaging applications for sending alerts via other means of communication (e.g. via ICQ or SMS). Let us assume that you wish to configure the Centericq application to send notifications about the Hardware Node state to your ICQ. To this effect, you should perform the following operations on the Monitor Node:

- Install the centericq package, for example:

```
# rpm -ihv centericq-4.21.0-1.i386.rpm
Preparing...        ########################################### [100%]
   1:centericq      ########################################### [100%]
```

- Configure the CUSTOM_ACTION and CUSTOM_LIST parameters in the /etc/vzrmond.conf configuration file to inform vzrmond that it should use the Centericq application for sending messages. For example:

```
...
CUSTOM_ACTION="centericq -s msg -p icq"
CUSTOM_LIST="-t 24359283"
...
```

  The parameters specified above mean the following:

  - the -s option is used to denote the type of event to be sent (in our case it is a message - 'msg');
  - the -p option is used to specify the destination instant messaging network (icq);
  - the -t option is used to indicate the ICQ UIN (Unified Identification Number) where the message is to be sent (24359283).

Note: Detailed information on all parameters that can be specified in the vzrmond.conf file is provided in the Parallels Virtuozzo Containers Reference Guide.

Using vzstatrep to Monitor Hardware Nodes

The vzstatrep utility allows you to analyze the main resources consumption of one or several Hardware Nodes and to receive information on this consumption in the form of statistic reports and graphics at your e-mail address(es). vzstatrep is included in the vzrmon package and automatically installed on the Monitor Node during the vzrmon package installation. For more information on how to install vzrmon, please see the previous subsection.

To start using vzstatrep, you should manually edit the vzstatrep.conf configuration file located in the /etc directory on the Monitor Node to define a list of Hardware Nodes whose resources consumption is to be analyzed and specify one or several e-mail addresses where the Hardware Node statistic reports and graphics are to be sent. In this file, you can also set a number of other parameters (e.g. the resources the usage of which will be presented in the graphical form with the help of the gnuplot utility or the path to the directory on the Hardware Node where vzstatrep will search for the logs to be analyzed). Detailed information on the vzstatrep.conf file and all its options is provided in the Configuring Parallels Virtuozzo Containers chapter of the Parallels Virtuozzo Containers Reference Guide.

By default, the vzstatrep utility is scheduled as a cron job to automatically run once a day. When launched, the vzstatrep utility performs the following operations:

- Connects to the Hardware Node(s) to be monitored;
- Downloads the logs collected by the vzlmond utility and stored in the /var/log/vzstat directory on the Hardware Node by default;
- Analyzes the downloaded logs and generates the statistic report and graphics on the basis of these logs;
- Sends the generated statistic report and graphics at the specified e-mail address(es).

Let us assume that you wish to analyze the resources statistics from the Hardware Node having the hostname of my_hardware_node.com and to periodically (i.e. once a day) receive this statistics report at the peter@my_domain.com e-mail address. To this effect, you should do the following:

1 On the Monitor Node, open the /etc/vzstatrep.conf file for editing:

```
# vi /etc/vzstatrep.conf
```

2 In the file, set the STATS_EMAIL and NODES parameters as follows:

```
NODES="my_hardware_node.com"
STATS_EMAIL="peter@my_domain.com"
```

3 Save the /etc/vzstatrep.conf file.

From now on, an e-mail message containing information on the Hardware Node resources consumption will be sent every day at the peter@my_domain.com e-mail address. However, if you wish to get the Hardware Node statistic report at the current moment, you can manually run the vzstatrep command on the Monitor Node:

```
# vzstatrep --plot --sendmail
```

As a result of this command, an e-mail message will be instantly sent to the `peter@my_domain.com` address containing the text information on the Hardware Node resources consumption (on the memory and CPU consumption on the Node, network statistics, etc.). Besides, you will get a number of attached files where the resources usage is presented in the form of graphics generated by the `gnuplot` utility. Detailed information on all `vzstatrep` options (including the `--plot` and `--sendmail` options used in the example above) is provided in the Virtuozzo Command Line Interface chapter of the Parallels Virtuozzo Containers Reference Guide.

Glossary

Application template is a template used to install a set of applications in *Containers*. See also *Template*.

Container (or *regular Container*) is a virtual private server, which is functionally identical to an isolated standalone server, with its own IP addresses, processes, files, its own users database, its own configuration files, its own applications, system libraries, and so on. Containers share one *Hardware Node* and one OS kernel. However, they are isolated from each other. A Container is a kind of 'sandbox' for processes and users. *Container 0* and *Container 1* are used to designate the *Hardware Node* and the *Service Container*, respectively.

Container 0 is used to designate a *Hardware Node* where the *Virtuozzo Containers* software is installed.

Container 1 is used to designate the *Service Container*.

EZ template is a template file that points to a repository with the packages that comprise the template. Unlike *standard templates*, EZ templates cannot be updated because the repository stays the same. However, the packages in the repository can be updated.

Hardware Node (or *Node*) is a server where the Virtuozzo Containers software is installed for hosting *Containers*. Sometimes, it is marked as *Container 0*.

Host Operating System (or *Host OS*) is an operating system installed on the *Hardware Node*.

MAC address stands for Media Access Control address, a hardware address that uniquely identifies each Node in a network. The MAC layer interfaces directly with the network media. Consequently, each different type of network media requires a different MAC layer.

OS template (or *Operating System template*) is used to create new *Containers* with a preinstalled operating system. See also *Template*.

Package set is a synonym for *Template*.

Parallels Infrastructure Manager (or *Infrastructure Manager*) is a tool designed for managing Hardware Nodes and all *Containers* residing on them with the help of a standard Web browser on any platform.

Parallels Management Console (or *Management Console*) is a Virtuozzo Containers management and monitoring tool with graphical user interface. It is used to control individual *Hardware Nodes* and their *Containers*. *Management Console* is cross-platform and runs on both Microsoft Windows and Linux workstations.

Parallels Power Panel is a means for administering personal Containers with the help of a standard Web browser (Internet Explorer, Mozilla, etc.) on any platform.

Parallels Virtuozzo Containers (or *Virtuozzo Containers*) is a complete server automation and virtualization solution allowing you to create multiple isolated *Containers* on a single physical server to share hardware, licenses, and management effort with maximum efficiency.

Private area is a part of the file system where *Container* files that are not shared with other *Containers* are stored.

SSH stands for Secure Shell. It is a protocol for logging on to a remote machine and executing commands on that machine. It provides secure encrypted communications between two untrusted hosts over an insecure network.

Service Container is a special *Container* automatically created on the Hardware Node during the Virtuozzo Containers installation and needed to manage your *regular Containers* by means of *Parallels Infrastructure Manager*, *Parallels Power Panel*, and *Parallels Management Console*. Sometimes, the *Service Container* is marked as Container 1.

Standard template is a template file that has inside itself all the re-usable files of all the packages comprising the template. If newer versions of any of these packages appear, a standard template can be correspondingly updated. Compare *EZ template*.

TCP (*TCP/IP*) stands for Transmission Control Protocol/Internet Protocol. This suite of communications protocols is used to connect hosts on the Internet.

Template (or *package set*) is a set of original application files (packages) repackaged for mounting over Virtuozzo File System. There are two types of templates. OS Templates are used to create new *Containers* with a preinstalled operating system. Application templates are used to install an application or a set of applications in *Containers*. See also *Standard template* and *EZ template*.

UBC is an abbreviation of *User Beancounter*.

User Beancounter is the subsystem of the *Virtuozzo Containers* software for managing *Container* memory and some system-related resources.

VENET device is a virtual networking device, a gateway from a *Container* to the external network.

Virtual Environment (or *VE*) is an obsolete designation of a *Container*.

Virtuozzo Control Center (or *VZCC*) is an obsolete designation of *Parallels Infrastructure Manager*.

Virtuozzo File System (*VZFS*) is a virtual file system for mounting to Container private areas. VZFS symlinks are seen as real files inside *Containers*.

Virtuozzo Server license is a special license that you should load to the *Hardware Node* to be able to start using the *Virtuozzo Containers* software. Every *Hardware Node* shall have its own Virtuozzo Server license.

Virtuozzo Power Panels (or *VZPP*) is an obsolete designation of *Parallels Power Panel*.

Virtual Private Server (or *VPS*) is an obsolete designation of a *Container*.

Parallels Agent (or *Parallels Agent Protocol*) is an XML-based protocol used to monitor and manage a *Hardware Node*. The *Parallels Agent* software implements this protocol and is a backend for the *Parallels Management Console*.

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